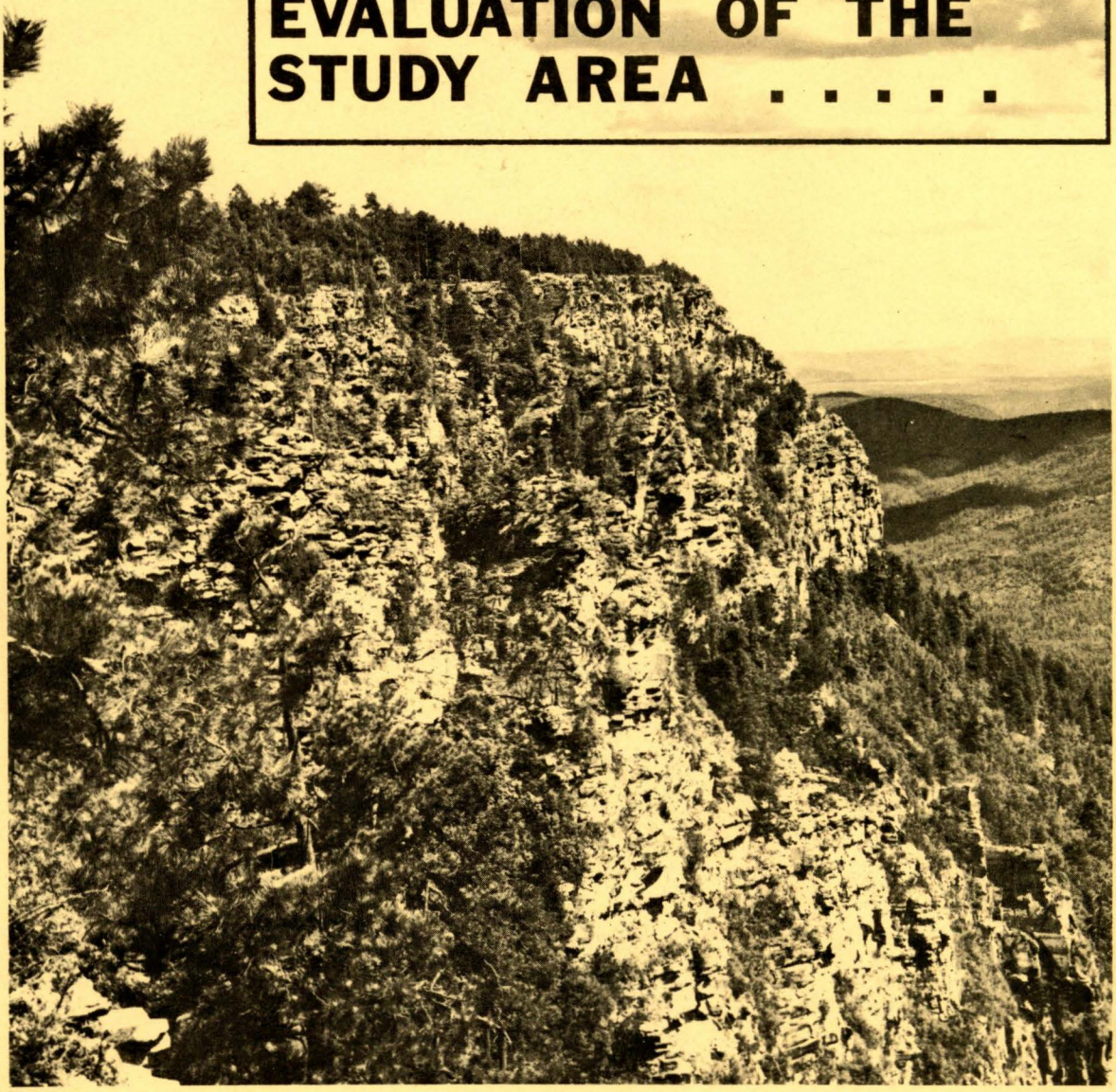
EVALUATION OF THE STUDY AREA . . . . .



MOGOLLON RIM AREA - LAND USE PLANNING STUDY.

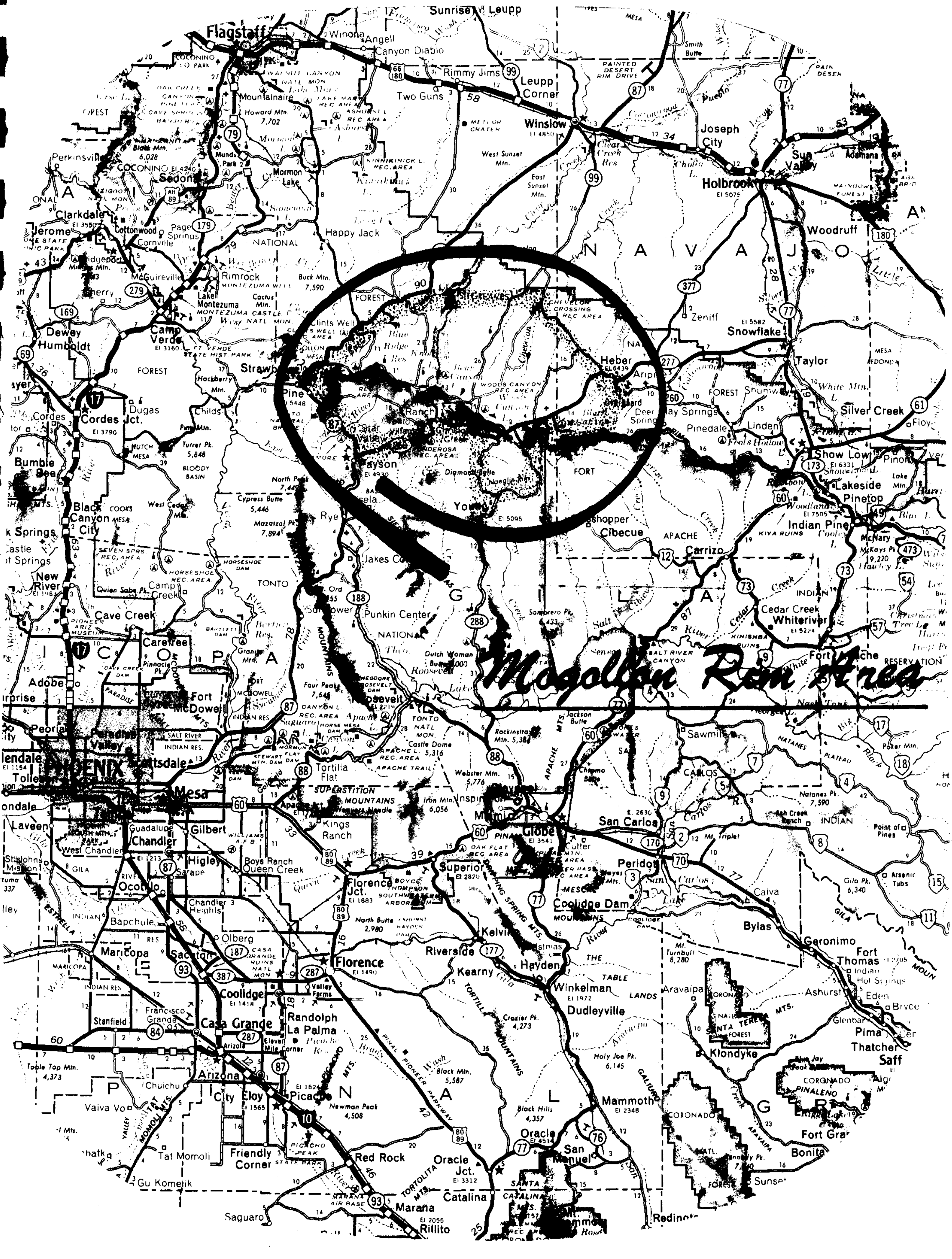
U.S. Department of Agriculture, Forest Service. . .
Coconino, Sitgreaves, and Tonto National Forests.

MOGOLLON RIM AREA

LAND USE PLANNING STUDY

EVALUATION OF THE STUDY AREA
(Environmental Analysis)

U.S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE
Coconino, Sitgreaves and Tonto National Forests
December 1972



Mogollon Rim Area
Flagstaff
Winona
Angell
Canyon Diablo
Sunrise
Leupp
Rimmy Jims
Leupp Corner
Two Guns
Winslow
Joseph City
Holbrook
Sun Valley
Woodruff
Mountainaire
Munds Park
Mormon Lake
Sedona
Clarkdale
Jerome
Cottonwood
Cornville
Page Springs
Happy Jack
Rimrock
McGuireville
Lake Montezuma
Camp Verde
Dewey
Humboldt
Strawberry
Pine
Payson
Star Valley
Heber
Overgaard
Zeniff
Snowflake
Taylor
Shumway
Show Low
Pinedale
Linden
Silver Creek
Lakeside
Pinetop
Indian Pine
McNary
Cibecue
Carrizo
Cedar Creek
Whiteriver
Fort Apache
Cordes
Cordes Jct.
Dugas
Childs
Bumble Bee
Black Canyon City
New River
Cave Creek
Carefree
Rye
Jakes Corner
Punkin Center
Young
Roosevelt
Tortilla Flat
Fort McDowell
Peoria
Scottsdale
Phoenix
Mesa
Tolleson
Laveen
Guadalupe
Chandler
West Chandler
Gilbert
Higley
Kings Ranch
Queen Creek
Florence Jct.
Superior
Miami
Inspiration
Globe
San Carlos
Peridot
Coolidge Dam
Bylas
Geronimo
Fort Thomas
Ashurst
Eden
Bryce
Pima
Thatcher
Klondyke
Aravaipa
Mammoth
Oracle
San Manuel
Oracle Jct.
Catalina
Marana
Rillito
Red Rock
Saguaro
Friendly Corner
Tat Momoli
Gu Komelik
Vaiva Vo
Chuichu
Eloy
Picacho
Arizona City
Casa Grande
Randolph
La Palma
Coolidge
Florence
Riverside
Kelvin
Kearny
Hayden
Winkelman
Dudleyville
Maricopa
Stanfield
Sacaton
Bapchule
Olberg
Ocotillo
Sawmill
Bonita
Fort Grant
Sunset
Redington
NAVAJO
FOREST
NATIONAL
TONTO
APACHE

MOGOLLON RIM AREA
EVALUATION OF THE STUDY AREA
(ENVIRONMENTAL ANALYSIS)

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"If one can view the biosphere as a single super-organism, then the Naturalist considers that man is an enzyme capable of its regulation, and conscious of it. He is of the system and entirely dependent upon it, but has the responsibility for management, derived from his apperception. This is his role - steward of the biosphere and its consciousness."

Ian L. McHarg, 1969

I. *Introduction*

EVALUATION OF THE STUDY AREA
(ENVIRONMENTAL ANALYSIS)

I. INTRODUCTION

A. Purpose and Objectives

This report is the result of completing the first steps of the Mogollon Rim Area Land Use Planning Study, of collecting and evaluating data about the study area. It summarizes in one document as much relevant planning information as has been possible to gather in the time and with the resources available for this study. It is intended for use as basic reference material during the succeeding steps of formulating management alternatives, establishing management direction, and the final preparation of a land use plan. This report makes no recommendations for management, and presents alternatives only to the extent of identifying the kinds of land uses which seem to be feasible on identifiable portions of the study area. It is an attempt to objectively evaluate the ecologic potential of the land, and the demand by people for the resource values which this area is capable of producing. To the extent possible, we have tried to identify the factors which influence land uses, and the result on the natural system.

B. Acknowledgements

Preparation of this report has been a collective effort on the part of an interdisciplinary study team, using material gathered or prepared by many individuals from each of the National Forests involved, from the Rocky Mountain Forest and Range Experiment Station, and from each of the Divisions of the Southwestern Region of the Forest Service. The members of the study team have actively sought the advice of many conservationists outside of the Forest Service, and their help and encouragement is gratefully acknowledged.

In the text of this report, we have tried to identify the sources of the information quoted. In the event, however, that we may not have properly identified each one, we should mention that valuable advice has been received from the following: Mr. Steven Carothers, Museum of Northern Arizona; Dr. Russell P. Balda, Northern Arizona University; Dr. Robert Ohmart, Arizona State University; Dr. Roger Hungerford, University of Arizona; and Dr. David A. King, University of Arizona. The Arizona Game and Fish Department was kind enough to lend us John Carr during the period the study team was analyzing the effects of land uses on each land resource response unit. We do not claim that any of the conclusions drawn in this report have the endorsement of any of these individuals or organizations.

It should be mentioned that the Multiple Use Management Advisory Council for each of the National Forests involved in this study have participated in reviews of the study plan, and of some of the study efforts. Their lively discussions served to highlight many problems we might otherwise have missed.

C. Our Approach to Planning

Multiple use planning for the National Forests is presently undergoing dynamic change and development, resulting in many new kinds of public involvement and written material. This report may therefore be puzzling to some readers who are not fully informed regarding the background and purpose of this study, or perhaps to others who are not intimately acquainted with the nature and purpose of planning on the National Forests. The following explanation is therefore offered as a more detailed justification for the report.

The Forest Service, which has a long background, is guided by a number of statutes, executive orders and legal decisions which have accumulated through the years.

There are three general activities assigned to the Forest Service by law. These are: (1) conducting forest and range research, (2) participating in cooperative forestry programs on State, local and private lands, and (3) managing and protecting the National Forests and Grasslands. We are concerned in this study with this last activity, and more particularly with developing a comprehensive plan to manage and protect a portion of three National Forests in Arizona.

The preparation of such a plan is guided primarily by two separate acts:

> The Multiple Use and Sustained Yield Act of 1960: "An Act to authorize and direct that the National Forests be managed under principles of multiple use and to produce a sustained yield of products and services, and for other purposes."
>
> The National Environmental Policy Act of 1969: "....to declare a national policy which will encourage productive and enjoyable harmony between man and his environment; to promote efforts which will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of man; (and); to enrich the understanding of the ecological systems and national resources important to the Nation...."

These Acts are indefinite insofar as describing how individual uses are to be distributed or combined on land areas of the National Forests. They do specify, however, that all products and services in harmony with the environment be given due consideration toward meeting the needs of Americans. In addition, they specify that: (1) there be provision of latitude for periodic adjustments in use to conform to changing needs and conditions, (2) relative values of the various resources in particular areas should be considered, (3) outputs should conform to the principle of sustained yield, (4) the greatest dollar return is not necessary, (5) a systematic interdisciplinary approach should be used, (6) appropriate consideration should be given to "presently unquantified environmental amenities and values," and (7) alternatives should be developed and studied to any proposal which involves unresolved conflicts. These provisions, by their broad nature, do not give a formula for specific solutions to problems and to their application on the ground. The crucial and perennially difficult problem of deciding upon which uses shall apply where, and how the land shall be managed for these uses, is left to the land administrator. Such decisions must be made, however, in full exposure to the changing and variously expressed needs of people. Technical judgements without consideration of needs, as well as they can be determined, are insufficient as a basis for deciding on land use. There is no formula or single procedure for determining and responding to changing public needs, This is part of the art of successful public land management.

The Mogollon Planning Study is an attempt to give "due consideration" to all of the products and services for which the land within the Rim area is suitable, to analyze the needs of our society which can be met through management of this area, and to develop alternatives leading to an allocation of areas of land to specific combinations of resource use and emphasis in a manner which meets the criteria listed above. A procedure and schedule have been prepared with the goal of completing a land use plan by July 1, 1973. This report (Evaluation of the Study Area) is the result of completing the first phase of the study. Succeeding phases will be concerned with making recommendations and arriving at decisions about land uses.

Many other kinds of planning are taking place throughout the Forest Service. Some kinds of planning are concerned with the management of individula resources, such as the preparation of timber management plans. Other planning is concerned with large scale regional efforts in cooperation with other agencies, such as river basin studies or the Western U. S. Water Plan. Some planning is based on detailed field studies and inventories, and generally leads to individual projects and actual work on the ground. Other kinds of planning may be based

on very broad estimates of values affecting large areas of land, and may result in policy changes or long range decisions. Planning efforts may involve detailed mapping of resource data and sophisticated computer models for analyzing and testing the data, or may be based on generalizations and simple data summaries.

The Mogollon Rim Study involves the type of planning often referred to as "comprehensive," "general" or "master" planning. In the Forest Service this is referred to as Multiple Use Planning, and is concerned with (1) coordinating National Forest land uses through the establishment of management direction or policies and (2) allocating National Forest land to specific combinations of uses and activities through the establishment of management zones (broad geographic areas with similar characteristics and management direction) and management units (localized areas where particular management decisions are required). Multiple Use planning is now being done for National Forests at two different level of intensity. The broadest level or focus of planning involves national planning areas, which are large geographic areas containing social and physical resources and land characteristics of a generally similar nature. The management direction for these areas is spelled out in a "Planning Area Guide" which gives direction to management zones. Within each Planning Area, smaller areas of closely related lands with uniformity in significant factors such as topography, population influences and land use, have been identified and are referred to as Planning Units. The Mogollon Rim Area is a Planning Unit, and planning efforts for this unit will focus on the identification of management units, and on making management decisions for these.

The method we have chosen to use in identifying logical management units, is to focus on taxonomic land types, based on landform, soil characteristics, vegetation, hydrologic characteristics, and climate. Areas on the ground which have characteristics common to each other and different from their neighbors are grouped together into units we have chosen to call Land Response Units (LRU's). Each of these units can be regarded as having similar possibilities and problems for land use, and will respond similarly to management (including protection). Chapter VI of this report describes, in detail, each of the 22 Land Response Units which have been identified for this Planning Unit. Each LRU has a number of characteristics which distinguish it, but two basic characteristics have been rated (high, medium, low) as a means of highlighting each LRU. These are (1) the relative capability of the land to support vegetation, and (2) the relative sensitivity of the land to activities and uses. The first, (capability), is a reflection of gradients of moisture regimes, heat relationships and nutrient supply, which are in turn, a summing up of the factors which affect each one. The second, (sensitivity),

is a reflection of soil erosion factors, runoff characteristics and slope as an expression of the magnitude and frequency of hazards to the land from activities that result in land disturbance. "Capability" ranks the LRU's according to their relative productive potential and "sensitivity" to the intensity of use which that unit can stand. Once the area has been separated into LRU's, the suitability of each one for various kinds of land uses is examined. This is described in Chapter VII of this report.

One more kind of information is needed to complete the data on which to base land use decisions, and that is, how much of the resource which is available and suitable for use should be allocated to that use. This involves consideration of the problem of resource demand. If certain kinds of uses and values are highly prized and in scarce supply, we would presumably consider devoting more acres to providing these values. The basic approach used in this study was for an interdisciplinary team to rate the effects of each kind of use within each LRU, on certain values thought to be significant to the American people.

By assigning relative weights to these values, the desirability of each kind of use can be assessed for each unit. In addition, the problem of demand has been examined from social and economic standpoints. This is discussed in Chapters IV and V. Two special studies were carried out to develop data for these chapters relative to demands for two land uses thought to be of major impact in this planning unit. These are: (1) the demand for land for residential development, and (2) the demand for outdoor recreation. Another study was made of the economic base of the study area in an effort to identify social and economic factors which might affect demands.

The final steps of land use planning are concerned with the actual decisions to be made in allocating land to different purposes. These steps are not discussed in this report, but will be the subject of future reports, as the steps are carried out. Briefly, we plan to propose and analyze alternatives for management units based on suggestions by the public. These will be analyzed and presented to the public through a Draft Environmental Statement. After public comments on this statement have been reviewed, a Final Statement will be prepared which presents a final decision regarding management units chosen.

"In the great chain of causes and effects no thing and no activity should be regarded in isolation."

Alexander von Humboldt, 1807

II. General Physical Description

II. GENERAL PHYSICAL DESCRIPTION OF AREA

A. Shape and Composition of the Land

Geology - Surface geology above the Mogollon Rim is relatively simple. The area is dominated by sedimentary rocks, chiefly Permian age limestone and sandstone. The next oldest rocks are the shales and sandstones of the Moenkopi formation. The most recent rocks are the Tertiary basalt flows and cinders.

The exposures on the face of the Mogollon Rim are predominantly Coconino sandstone underlain by the Supai formation.

Below the Rim the geology is more complex. Generally, bands of sedimentary rock extend in an east-west direction across the area. From north to south, the dominant formations are members of the Supai shales and sandstones, Coconino sandstone, carboniferous shale and sandstone, and limestones of the Redwall and Martin formations. The oldest rocks in the area are the Precambrian granites and granodiorites in the south central part of the area near Payson. Tertiary basalt flows occur in the southwest part of the area. Some old alluvium is present both above and below the Rim.

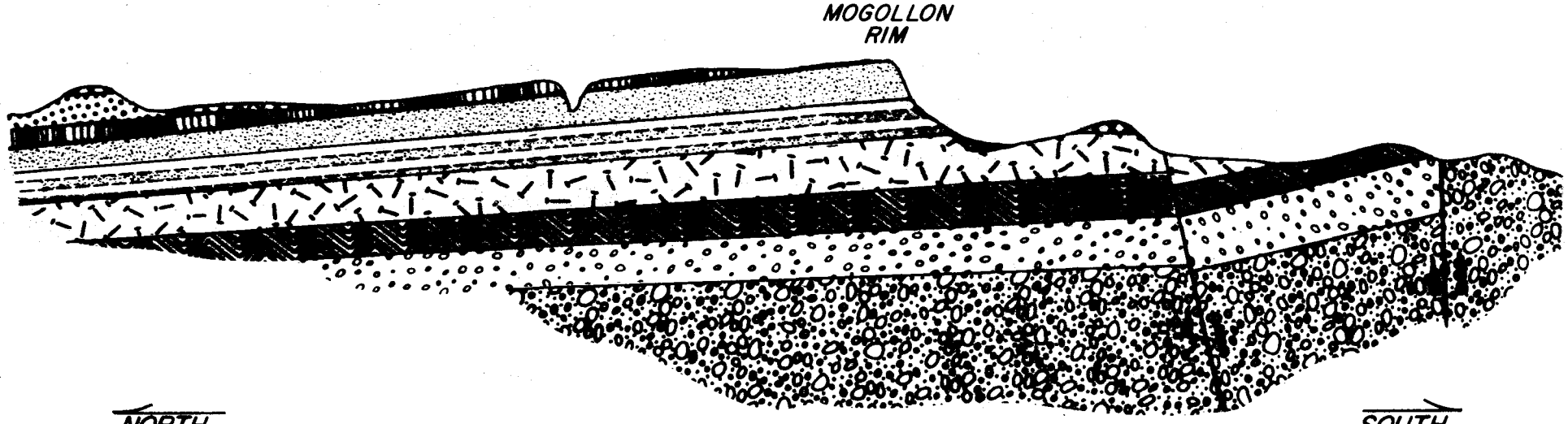
Geomorphology - The area above the Rim is part of the Colorado Plateau. It is a high, dissected plateau that consists of a series of narrow, nearly level interfluves and numerous drainages and canyons. Elevations range from about 6,200 feet in the north to 8,074 feet atop Baker Butte.

One of the most prominent features in the study area is the Mogollon Rim itself. It is a scarp formed by prolonged and accelerated erosion during periods of general uplift. This erosion exposed the older formations to the south of the Rim, as it deposited thousands of feet of alluvium in the Basin-Range valleys.

Most of the area below the Mogollon scarp consists of low hills and basins, and benchlands. Alluvial plains and terraces are important land form features adjacent to the major streams. Elevations generally range from about 4,600 feet to 6,400 feet.

Soils - The soils on the Plateau generally are moderately deep and deep, well to somewhat poorly drained, and have thick gravelly or cobbly loam or fine sandy loam surface layers underlain by reddish-brown clay. The soils generally become shallower toward the north part of the area. The soils from basalt and cinders generally are

Generalized Geologic Section of the Mogollon Rim Area



LEGEND

- QTb - Basalt
- Trm - Moenkopi Fomation
- Pk - Kaibab Limestone
- Pc - Coconino Sandstone
- PPs - Supai Sandstone and Shale
- Ts - Tertiary Sediments
- CDI - Naco Formation (Limestone), Redwall Limestone, Sandstone, & Quartzite
- Et - Tapeats Sandstone, Troy Quartzite
- Au - Apache Group (Limestone, Quartzite, Conglomerate & Shale)
- gr - Pre-cambrian Granite

moderately fine or fine textured, gravelly and stony, well-drained and brown or reddish-brown in color. The soils along the scarp are shallow to moderately deep, weakly developed and derived from colluvial materials. Soils in the hill and basin area generally are shallow to deep, with stony surface layers underlain by reddish-brown clay loam to clay subsoils. The soils from deeply weathered granitic materials are weakly developed, coarse textured, and well-drained. Soils from alluvium on the plains and terraces are deep, stony, moderately coarse to moderately fine textured and are subject to periodic flooding.

Minerals - Mineral deposits are relatively inconspicuous in the study area. Except for the use of common varieties of rock, primarily for road construction, there are no active workings for minerals within the study area.

All of the area north of the Rim is overlain by post-mineral formations which are thousands of feet thick. Mineralization of this area is not known at this time due to the inadequacy of present techniques to locate ore bodies at this depth. To the south of the Rim, the Paleozoic formations, and large areas of the Precambrian igneous and metamorphosed sedimentary rock complexes have been exposed. Economic deposits of structural clay and hematite are known, but their extent and present feasibility for development seems to be limited. This area is known to contain numerous occurrences of gold, silver, copper, lead, zinc, flourspar and uranium minerals.

B. Climatic Factors

The general climate within the study area varies from semi-arid to sub-humid, according to Thornthwaite's classification. Average annual precipitation varies from 12 inches near the northern boundary to over 30 inches along the Mogollon Rim.

The area has a pleasant summer climate due to its relatively high elevation, with warm days reaching temperatures in the nineties, and occasional temperatures above one hundred at the lower elevations. Summer nights are cool and pleasant. Generally, relative humidities are quite low.

Winter is characterized by mild days and cold nights, with average daytime temperatures above freezing. Sub-zero readings are frequently recorded, although there are occasional mild winters when these are rare.

The area is located in a broad region of well defined wet and dry periods. Normally, mid-summer is the wettest part of the year, with

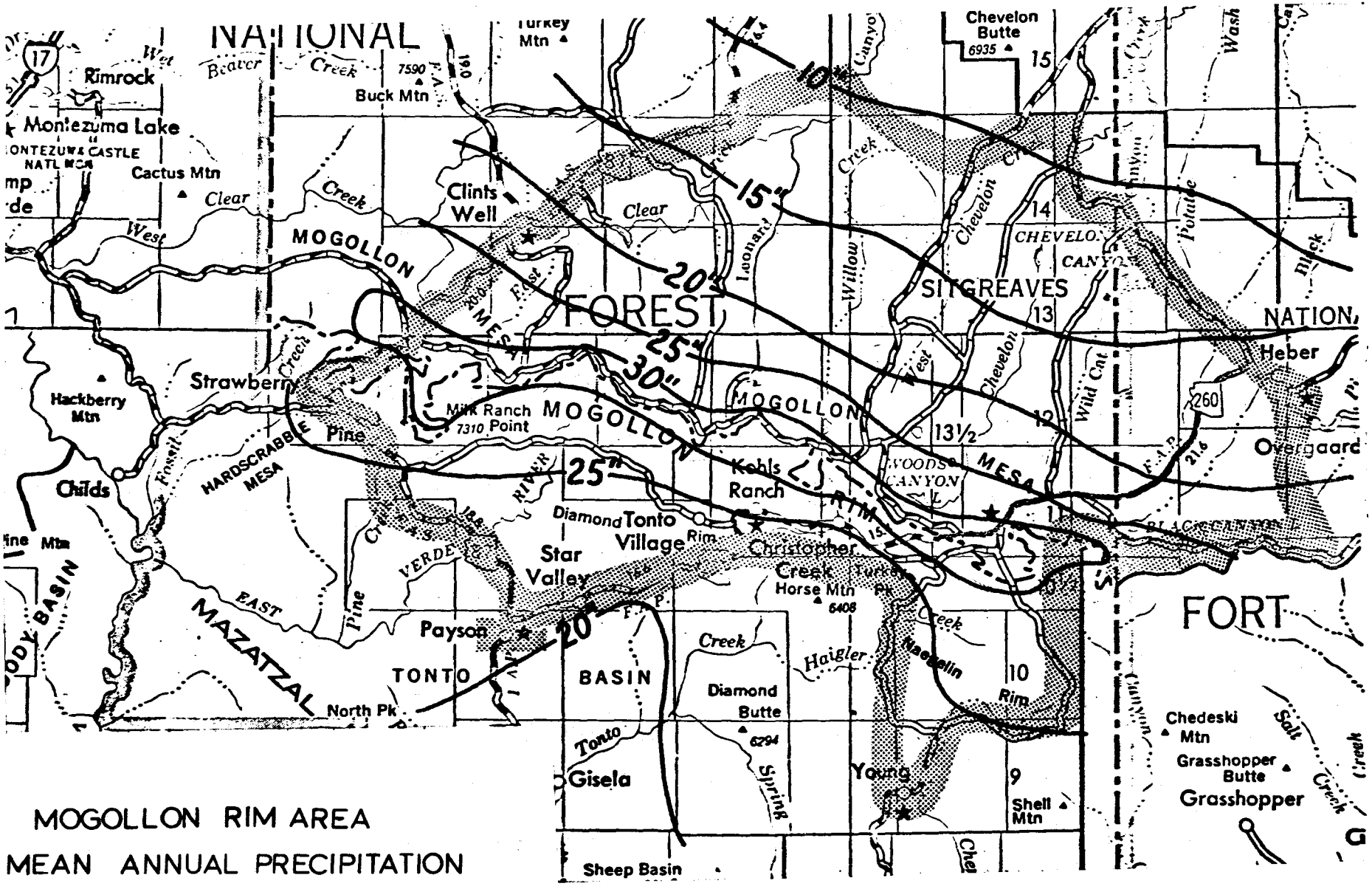
almost daily afternoon showers and thunderstorms somewhere within the study area. These storms develop from thermal and orographic lifting of moist tropical air which moves into Arizona from the south. Occasionally, dissipating tropical disturbances moving north and east from the Gulf of California and the Pacific Ocean produce heavy rains which may continue for several days.

Winter weather patterns are much less consistent, and precipitation varies considerably in amount and frequency from year to year. Winter storms are associated with maritime polar air masses moving eastward from the Pacific Ocean, and while precipitation is less intense than during summer, it may be widespread and long lasting, with strong winds blowing steadily for several days. Snow accumulations at the higher elevations along the Rim are common from December through February.

CLIMATIC DATA OF SELECTED STATIONS [1]

	TEMPERATURE(°F.)				MEAN PRECIPITATION TOTAL (INCHES)			
	ANNUAL MEANS		EXTREMES					AVERAGE GROWING SEASON
	DAILY MAX.	DAILY MIN.	RECORD HIGH	RECORD LOW	TOTAL ANNUAL	SNOW FALL	ELEVATION	(DAYS)
Heber R.S.	64.9	30.2	97	-28	17.75	46.6	6,600	102
Payson	70.6	34.9	104	-18	21.38	26.3	4,906	138
Chevelon R.S.	63.1	32.0	96	-22	17.96	64.1	7,006	132
Natural Bridge	70.2	45.2	105	6	23.89	20.8	4,607	210

1) Smith, H.V., 1956
The Climate of Arizona, Arizona Experiment Station Bulletin 279.



MOGOLLON RIM AREA

MEAN ANNUAL PRECIPITATION

C. Hydrologic Conditions

Surface Runoff

Drainages north of the Mogollon Rim are parts of the Little Colorado River Basin. Within the study area, these include East Clear Creek, Leonard Canyon, Willow Creek and Chevelon Creek as the major perennially flowing streams. To the south of the Rim, drainages into the Salt-Verde System from the study area include Canyon Creek, Tonto Creek and the East Verde River. On both sides of the Rim, many smaller drainages carry perennial flows for at least part of their lengths.

WATER DISCHARGE AT SELECTED STATIONS [1]

Station	Drainage Area Sq. Mi.	Average Discharge Area Inches	Average Discharge cfs	Total Acre Ft/Year	Maximum Discharge cfs	Minimum Discharge cfs
E. Clear Creek (Willow Creek)	321	3.26	77	55,790	16,400	0
Cherry Creek (Young)	62	2.25	10	7,460	3,400	0.05
Tonto Creek (Gisela)	430	4.04	128	92,740	38,000	3.5
East Verde (Dude Creek)	7	3.30	22*	16,210*	2,820	0
Webber Creek (Camp Geronimo)	5	6.55	2	1,720	1,220	0.2
Chevelon Creek (Wildcat)	275	2.45	50	35,860	19,800	0

*Includes diversion from East Clear Creek of 15,000 acre feet.

Water runoff can be expressed simply as a result of precipitation minus evapotranspiration, plus or minus a change in soil moisture storage. The climatic feature of the study area, of well defined wet and dry periods, creates a unique situation for soil moisture storage. The soils are normally saturated by winter moisture, then are depleted to the wilting point through evaporation and transpiration during the spring dry season. The surface soils are practically dehydrated and very receptive to moisture when the summer rains start. During the summer season, soil moisture gradually picks up as the rains intensify, and soil moisture is usually up to field capacity by August, but by this time precipitation is beginning to taper off. By winter soils may again be at less than capacity.

1) United States Department of the Interior, Geological Survey, Water Resources Data for Arizona, 1970.

Except for peaks associated with massive storms such as that of September 4-7, 1970, most runoff from the study area occurs in the spring as a result of snow melt over soils at field capacity. Because there are distinct and sometimes irregular periods of water deficit, it can be seen that total runoff from the study area can vary considerably, probably within a range from 0.75 area inches for low years, to 5.25 inches in a high year. In addition, there is the definite possibility of heavy flooding in individual drainages, regardless of the hydrologic condition of the watershed, if soil saturation is coincident with either rapid snow melt or heavy precipitation.

Water quality is considered to be good throughout the study area, as determined by our present modest program of tests and monitoring. With minor exceptions, such as near subdivisions and urban developments, few contaminants have been detected. Sediment loads, water temperatures, and other natural qualities are not thought to have been unduly affected by management practices to date, as ground cover density (plants and litter) is good over most areas. Sediment yields are estimated to be less than 0.2 acre feet per square mile per year, with the primary sources being roads and stream channels.

Ground Water

Alluvial aquifers are limited throughout the study area. To the north of the Mogollon Rim, most ground water is contained within a consolidated rock aquifer consisting of the Permian age Coconino sandstone and Supai formations.[1] Yields from this aquifer are relatively small (50 to 500 gallons per minute) at depths down to 1,500 feet. Quality from this source varies somewhat, but is generally adequate for use without treatment. Recharge of this aquifer is thought to occur throughout the area as a result of subsoil saturation in the winter and early spring.

To the south of the Rim, aquifers are not well understood, but must occur in igneous and metamorphic rocks and well-consolidated sedimentary rocks that contain only small amounts of space for storage of ground water.[2] Depths to water within the study area range from 200 to 800 feet, with few wells producing more than 10 g.p.m. Water quality is good. Aquifer recharge is likewise not well understood in this area, but is likely to be very slow and over wide areas. Many small streams are known to disappear not far from the Rim, near to contact between Permian and Mississippian age formations, but it is possible they are merely hidden by alluvium at this point.

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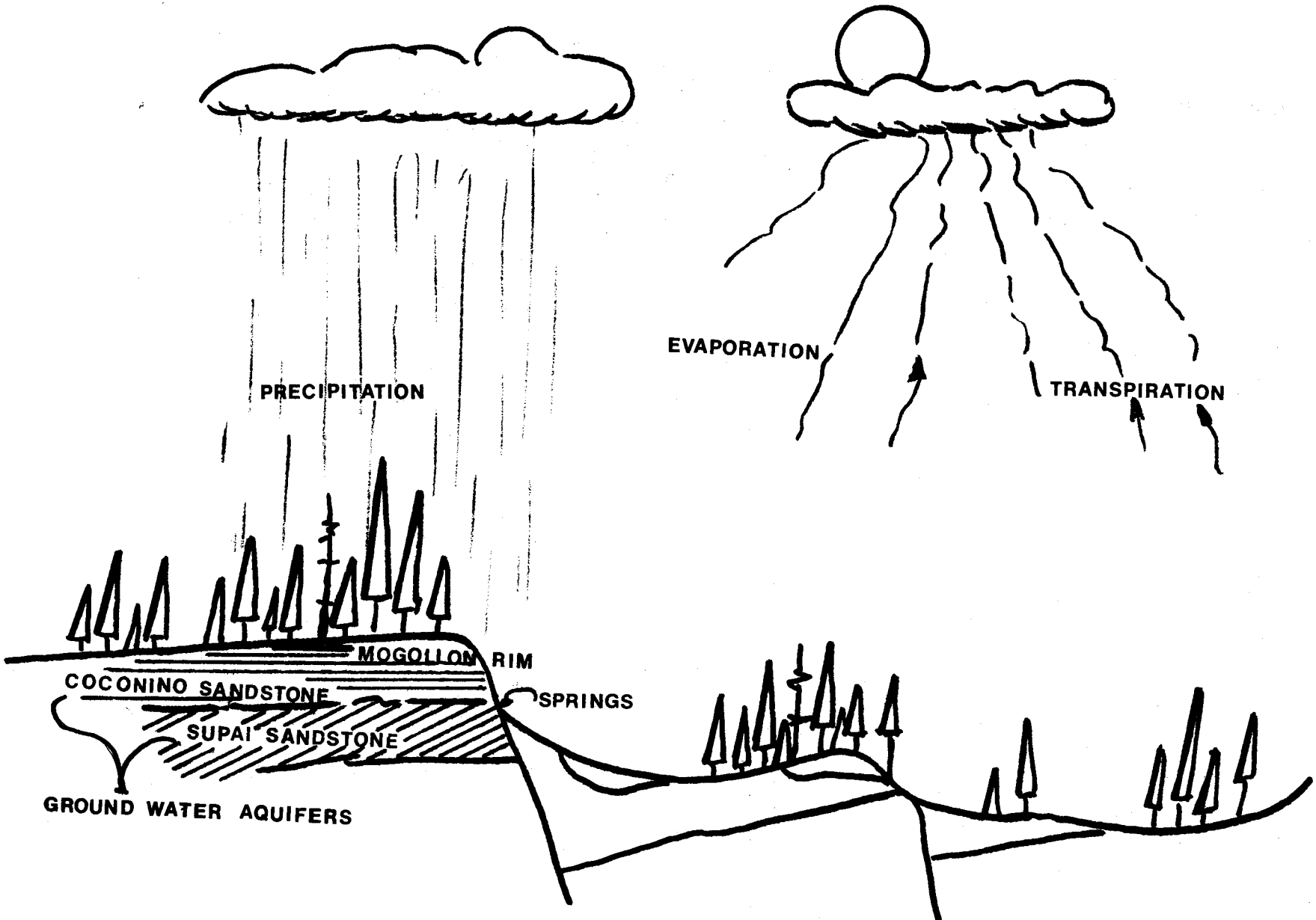
1) McGavock, E.H., 1968
Basic ground water data for southern Coconino County, Arizona, U.S. Geological Survey.

2) Annual report on ground water in Arizona, spring 1970 to spring 1971, prepared under the direction of H.M. Babcock, Arizona District, Water Resources Division, U.S. Geological Survey, 1972.



HYDROLOGIC CYCLE

D. Vegetation

While the concept of a biotic community, including both plants and animals, is necessary toward developing a true understanding of our ecosystem and the changes we bring about in it, the great complexity of even the simplest communities is staggering. No biologist should pretend to be competent enough in the taxonomy, life histories and ecology of all the organisms of an average community to study them thoroughly as a unit. When one considers in addition, the need to understand the effects of the environment, ranging from geologic forces and time to daily meteorologic changes, it can be seen that any study of communities must involve workers in many fields, each looking at segments of the problem.

The plant portion of a community is usually the most visible, the most stable through the year, and the easiest to classify and categorize. We have, therefore, chosen vegetation as a major component of the Rim area requiring description.

If one were to draw a line around the area occupied by each species of plant, it would be found that scarcely any two of them would coincide exactly. Some plants are found to range throughout a great variety of conditions, and are widely distributed. Others, with more exacting requirements, are found only in limited areas. The distribution of plants, and their association together, depends on the site conditions present in a given area, as well as the requirements of each plant species, and the events which disseminate them over the landscape. Plants, therefore, tend to be grouped in different combinations forming more or less definite communities, each of which is characterized by certain plants, and located generally on similar sites. Arizona, with a great variety of plants, as well as a great variety of sites, has a large number of vegetative types.

Many classifications of plant communities have been made, using a number of different concepts, but none has gained universal acceptance. Workers in synecology (a study of groups of organisms as communities) may tend to lump or to split, according to their individual opinions. For the purposes of this study, we have chosen to make tentative descriptions of 16 plant communities within 5 vegetative associations. These descriptions are based primarily on the observations and opinions of Forest Service range conservationists and wildlife biologists who are familiar with the vegetation of the area. It is hoped that these descriptions will serve to improve the understanding of the condition and potential of the Rim Area. Much further work is needed in Arizona to define and describe plant communities and habitat types. The following is an outline of the plant communities described:

Vegetative Association	Plant Community
Pine-fir forest	1. Fir-aspen
	2. Pine-fir
	3. Mountain-meadow
	4. Alder-maple
	5. Maple-alder
Ponderosa pine forest	6. Ponderosa pine
	7. Ponderosa pine-Emory oak
	8. Oak-sycamore
	9. Pine bunchgrass park
Pinyon-juniper woodland	10. Pinyon-juniper
	11. Pinyon-juniper-shrub
	12. Cottonwood-willow
Grassland	13. Juniper-oak
	14. Desert grassland
	15. Shortgrass grassland
Chaparral	16. Chaparral

The vegetative associations have been mapped for the Mogollon Rim Area. The plant communities represent areas within each association with identifiable differences in composition and physiognomy. For land use planning purposes such areas are too small to map, but have been described, as an aid to understanding the interactions which take place within each vegetative association. The following are descriptions of each plant community.

1. Fir-Aspen Community

Physiography and Climate - The fir-aspen community is generally found at elevations near 8,000 feet. Lower elevation extensions can be found on north-facing slopes and in the heads of northerly draining canyons near the Rim. With the exception of riparian and meadow communities, the fir-aspen community exists on the wettest and coolest sites found in the study area.

Vegetation - Douglas-fir, white fir, and quaking aspen dominate the overstory. Limber pine and ponderosa pine can be found on the drier sites. The shrub component of the vegetation is typified by Rocky Mountain maple, Oregongrape, currant, raspberry, and New Mexican locust. The understory is characterized by brome, Kentucky bluegrass, sedge, strawberry, honeysuckle, geranium, violet, goldenpea, peavine and bracken fern.

The overstory approaches a closed canopy under undisturbed conditions. Overstory regeneration is limited to somewhat shade tolerant species

such as white fir and Douglas-fir. When the overstory canopy is opened up through logging or natural disturbance, shade intolerant aspen, ponderosa pine, limber pine, and New Mexican locust are often established and occupy the site for a successional stage.

A reduction in canopy coverage and ground cover disturbance also favors the establishment of raspberry, rose, strawberry and on some sites bracken fern. Rough bent, a weak perennial grass, and goldenpea are often the first herbaceous plants to occupy disturbed sites.

2. Pine-Fir Community

Physiography and Climate - The pine-fir community is found from 6,800 to 8,000 feet in elevation where precipitation exceeds 25 inches annually. The lower elevation extensions occur on north facing slopes and drainages.

Vegetation - The overstory is dominated by ponderosa pine, Douglas-fir and Gambel oak. White fir is found on the more moist sites. Occasional Southwestern white pine can be found throughout. The shrub layer consists primarily of Fendler's ceanothus, manzanita and rose on the drier sites. New Mexican locust and Oregongrape commonly occur on mesic sites with currant and myrtle boxleaf present on the moist sites. The understory consists of Arizona fescue, screwleaf muhly, Kentucky bluegrass, dryland sedge, prairie Junegrass, goldenpea, woodbetony and western yarrow.

The more moist sites often support nearly a closed overstory canopy. Tree regeneration is largely limited to white fir and Douglas-fir on these sites unless the canopy is opened up. Reduced canopy cover present on drier sites permits the regeneration of ponderosa pine and Gambel oak. New Mexican locust and Fendler's ceanothus become established rapidly on sites severely disturbed.

3. Mountain Meadow Community

Physiography and Climate - Mountain meadows occur on wet to intermittently wet sites within the ponderosa pine and pine-fir associations. Typically, meadows are found on flat to gently sloping terrain. They occur adjacent to stream courses and lakes which provide a source of surface or subsurface water within reach of the roots of herbaceous plants. Mean annual precipitation is 18 to 28 inches.

Vegetation - Grasses, forbs, sedges, and rushes dominate meadows. Shrubby to tree form Bebb willow is present within some of the more

protected meadows. Aspen frequently borders meadow communities in the transition zone between moist and moderately dry sites. Dominant herbaceous plants are tufted hairgrass, timothy, redtop, rough bent, Kentucky bluegrass, sedges, rushes, clover, and dandelion.

Excessive grazing pressure has a damaging effect, particularly on dry to intermittently dry meadows. Vegetative composition is reduced rather rapidly to invader plants such as Arizona sneezeweed, dandelion, Rocky Mountain iris, rough bent, and foxtail. Disturbances such as roads, trails, and overgrazing which tend to cause gullies and lower the water table in meadows are followed by rapid changes in the vegetation to more xeric species. Woody plants including conifers are then able to encroach upon the previously mesic to wet site..

4. Alder-Maple Community

Physiography and Climate - The Alder-Maple community is found on riparian sites in the heads of southerly flowing drainages in the pine-fir association. These sites are cold and wet. Surface water is occasionally present.

Vegetation - Bigtooth maple, Arizona alder, and inland boxelder predominate the overstory. Snowberry and red-osier dogwood are common shrubs. The understory is typified by monkeyflower, golden columbine, Kentucky bluegrass, brome and sedge.

5. Maple-Alder Community

Physiography and Climate - The Maple-Alder community occurs on riparian sites in the heads of northerly flowing drainages in the pine-fir association. These sites are cold and wet with surface water present as spring or stream flow much of the year.

Vegetation - Rocky Mountain maple and thinleaf alder dominate the overstory. Scouler willow, Bebb willow and inland boxelder also occur in the overstory. Shrubs are predominately red-osier dogwood, honeysuckle, currant, snowberry, and rose. The understory is largely composed of golden columbine, monkeyflower, clover, New Mexican checkermallow, Kentucky bluegrass, brome and sedge.

6. Ponderosa Pine Community

Physiography and Climate - This community is present over the bulk of the Mogollon Plateau at elevations from 700 to 8,000 feet where precipitation ranges from 18 to 28 inches annually. At the higher elevations

ponderosa pine is found in the drier sites, south and west facing slopes, and on shallow soils. The reverse is true for the lower extensions of the community.

Vegetation - The overstory is primarily ponderosa pine. Pine stands range from open park-like stands of mature trees to dense clumps of seedlings or saplings. Gambel oak is found throughout the ecosystem in varying degrees of abundance. Alligator juniper is present on some sites with dense sprouting of this species common in certain areas.

Shrubs consist primarily of Fendler's ceanothus, rabbitbrush, skunkbush, New Mexican locust, Gray oak and young Gambel oak. The understory consists of mountain muhly, Arizona fescue, screwleaf muhly, pine dropseed, squirreltail, prairie Junegrass, Arizona three-awn, muttongrass, western yarrow, hairy goldaster, fleabane, geranium, goldenpea, and lupine.

A reduction in canopy coverage and soil disturbance favors ponderosa pine regeneration except on dry sites. It also favors alligator juniper, Gambel oak and New Mexican locust invasion and re-establishment. It is probable that recurrent wildfire prior to 1900 prevented alligator juniper from extensively occupying ponderosa pine sites. The presence of scattered mature alligator juniper indicates that the species is adapted to dry to moderately moist sites in the ponderosa pine ecosystem. Protection from fire and the opening of pine stands through selective cutting has apparently favored the rapid release of established alligator juniper.

7. Ponderosa Pine-Emory Oak Community

Physiography and Climate - This community is found on the immediate edge and the face of the Mogollon Rim. Soils are shallow and the exposure is generally south. Mean annual precipitation is about 20 to 28 inches.

Vegetation - The overstory is dominated by ponderosa pine, emory oak and Arizona white oak. Pinyon, alligator juniper and Gambel oak are present to a lesser degree throughout most of the ecosystem. Shrubs are predominately hairy and birchleaf cercocarpus, New Mexican locust, pointleaf manzanita, buckthorn, and agave. Understory species are predominately pine dropseed, prairie Junegrass, dryland sedge, longtongue muhly, and fleabane.

8. Oak-Sycamore Community

Physiography and Climate - The Oak-Sycamore community occurs on riparian sites within the Ponderosa Pine association and Pinyon-juniper woodland below the Rim at elevations within the study area from 4,500 to 5,500 feet. Surface water is limited to occasional springs and runoff from summer rains.

Vegetation - Arizona sycamore, Arizona walnut, and Arizona white oak predominate the overstory. Fremont cottonwood, Arizona alder, and Arizona ash can also be found. The shrub canopy consists of sugar sumac, seepwillow bacharis, coyote willow, algerita, honeysuckle, Virginia creeper, and canyon grape. Bermudagrass, three-awns, spiderling, filaree, and spurge can be found in the herbaceous understory. Periodic flash flooding in this community keeps the vegetation in perpetual succession as both overstory and understory are lost in varying degrees depending upon the severity of seasonal flash floods.

9. Pine Bunchgrass Park Community

Physiography and Climate - The pine bunchgrass park community occurs on gently rolling to relatively level terrain within the ponderosa association. The soils supporting this vegetation are generally moderately deep to deep, well developed and moderately to highly productive.

Vegetation - The characteristic vegetation is composed of bunch-form grasses. Predominant species are Arizona fescue, mountain muhly, screwleaf muhly, pine dropseed, squirreltail, prairie Junegrass, Arizona three-awn, muttongrass, western yarrow, hairy goldaster, fleabane, geranium and red-and-yellow pea. A scattered overstory of ponderosa pine is frequently present, particularly around the fringes of the grassland community. Shrubs occur on the rockier well-drained soils. Fendler's ceanothus, skunkbush and shrubby Gambel oak are the most abundant shrubs.

The impact of past sheep grazing has reduced herbaceous plant composition to predominately bunchgrasses over parts of the ecosystem. Desirable forbs are absent or at best rare on most sites. On many of the rockier sites suited to deep rooted speices there may be dense stands of Fendler's ceanothus. In the absence of fire, ponderosa pine often encroaches upon pine bunchgrass parks from adjacent conifer stands. Fendler's ceanothus stands become decadent and eventually disappear in the absence of fire.

10. Pinyon-Juniper Community

Physiography and Climate - The pinyon-juniper community occupies the northern border of the planning unit above the Mogollon Rim at elevations from 6,200 to 6,800 feet. Precipitation ranges from 12 to 16 inches annually.

Vegetation - The overstory is dominated by one-seed juniper and pinyon. Ponderosa pine, Gambel oak, and alligator juniper are significant components of the overstory on the more moist sites. Shrubs consist primarily of skunkbush, rabbitbrush, fourwing saltbush, and fringed sage. Cliffrose and fernbush are common on rocky soils derived from limestone. Herbaceous plants are represented by blue grama, side-oats grama, squirreltail, western wheatgrass, Fendler three-awn, ring muhly, sand dropseed, galleta, mutton bluegrass, winterfat, red-and-yellow pea, fleabane, hairy goldaster and milkvetch.

Climax pinyon-juniper stands are associated with the shallow, rocky soils generally found on ridges. Grazing, together with control of wildfires, may have enabled these woody species to encroach into areas of shortgrass grassland, resulting in a reduction of spring growing bunchgrass species in favor of sod-forming summer-growing blue grama and invader species.

11. Pinyon-Juniper-Shrub Community

Physiography and Climate - This community occurs on the face of the Mogollon Rim and below the Rim to an elevation of approximately 4,500 feet. Precipitation ranges from 18 to 26 inches annually.

Vegetation - Overstory species are predominately Utah juniper, alligator juniper, pinyon, and ponderosa pine. Emory oak and Arizona white oak are also present on some sites. Shrub species are commonly pointleaf manzanita, Wright silktassel, desert ceanothus, Fendler's ceanothus, birchleaf cercocarpus, shrub live oak, California buckthorn, agave, and beargrass. Herbaceous plants are predominately side-oats grama, hairy grama, blue grama, Fendler's three-awn, squirreltail, plains lovegrass, muttongrass, and cane beardgrass.

12. Cottonwood-Willow Community

Physiography and Climate - The cottonwood-willow community occurs along drainages within the ponderosa pine and pinyon-juniper associations. Surface water from perennial streams is common. Drainage

bottoms are generally narrow, rocky-gravelly sites.

Vegetation - Narrowleaf cottonwood, Goodding willow, Arizona walnut, and inland boxelder dominate the overstory. Gambel oak, fragrant ash, one-seed juniper and ponderosa pine are often present in varying abundance. Shrubs are predominately willow, New Mexican locust, canyon grape, rose, brickellia, indigobush, amorpha, water birch and thinleaf alder. Fernbush and cliffrose are common on the slopes of drainages dissecting limestone formations. Common herbaceous plants are western wheatgrass, needle-and-thread, blue grama, Canada wildrye, little bluestem, side-oats grams, Kentucky bluegrass, sedge, false tarragon safebush, and geranium.

13. Juniper-Oak Community

Physiography and Climate - The juniper-oak community occurs below the Mogollon Rim in the study area at elevations from 4,500 to 6,000 feet. Precipitation ranges from 20 to 25 inches annually.

Vegetation - The overstory is dominated by alligator juniper and Arizona white oak. Other associated trees are Utah juniper, Emory oak, pinyon pine, and ponderosa pine. Shrub composition consists primarily of shrub live oak, rabbitbrush, snakeweed, yerba-de-pasmo, and skunkbush. Herbaceous plants include bluegrama, side-oats grama, sand dropseed, plains lovegrass, curlymesquite, jackass clover, goldeneye, and hairy goldaster. A common invader is deerhorn cholla.

14. Desert Grassland Community

Physiography and Climate - The desert grassland community occurs below the Rim at elevations below 5,000 feet. Precipitation ranges from 20 to 24 inches annually. Generally, the community is found on benchlands where soils are relatively shallow. The scarcity of such sites severely limits the acreage of desert grassland in the planning unit.

Vegetation - The predominate vegetation is composed of grasses, shrubs, and halfshrubs. The most abundant species are side-oats grama, hairy grama, black grama, curlymesquite, and broom snakeweed. Velvet mesquite invasion is common on some sites.

In the absence of fire, desert grasslands become dominated by velvet mesquite and cactus. Heavy grazing results in the more desirable grasses being replaced by curlymesquite, slender grama, Rothrock grama, and broom snakeweed.

15. Shortgrass Grassland Community

Physiography and Climate - The shortgrass grassland extends northward from the pinyon-juniper community at 6,200 to 6,800 feet elevation. Precipitation ranges from 12 to 15 inches annually. The topography is generally flat to rolling, occasionally dissected by rather deep drainages.

Vegetation - The overstory consists of scattered pinyon pine, one-seed juniper, and alligator juniper on better drained sites. Deep soils and poorly drained sites are usually free of tree-form vegetation. Shrubs are predominantly fourwinged saltbush, winterfat, wolfberry, snakeweed, and rabbitbrush. Understory species are commonly blue grama, western wheat, galleta, Fendler three-awn, needle-and-thread, ring muhly, sand dropseed, fleabane and herbaceous sages.

Grazing has reduced the abundance of browse species and the taller, spring growing grasses over much of the shortgrass ecosystem. Blue grama often comprises over 80 percent of the vegetative cover. Severely depleted sites regress to Fendler three-awn, ring muhly and eventually to Russian thistle.

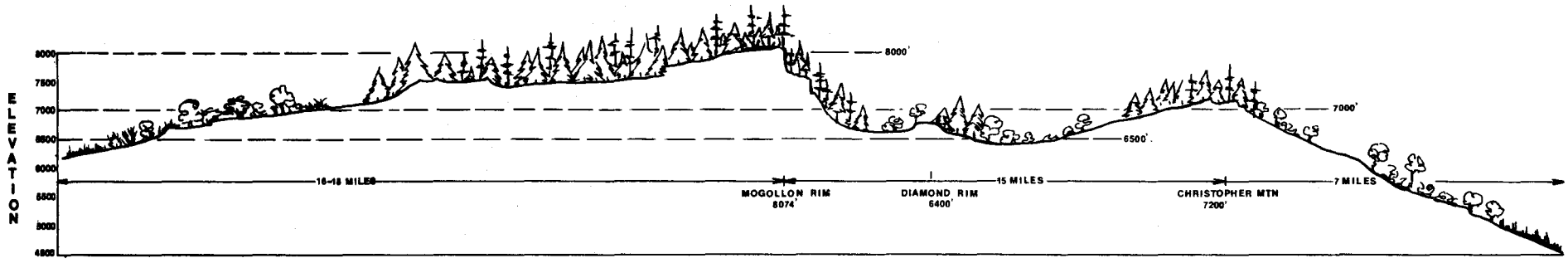
16. Chaparral Community

Physiography and Climate - Chaparral occurs in the study area below the Rim at elevations from 4,200 to 6,500 feet. Annual precipitation varies from 20 to 25 inches.

Vegetation - The following shrubs make up the dominant overstory: shrub live oak, sugar sumac, skunkbush, pointleaf and Pringle manzanita, hollyleaf buckthorn, desert ceanothus, birchleaf cercocarpus, Wright silktassel and wait-a-bit. Beargrass is also present in the dominant overstory layer. A scattered tree overstory, often restricted to the moister sites, is represented by Arizona cypress, ponderosa pine, Douglas-fir, pinyon pine, juniper, Emory oak, or mesquite. Herbaceous species are commonly side-oats grama, hairy grama, bullgrass, deergrass, buckwheat, beardtongue, Dakota verbena, and Louisiana wormwood.

With few exceptions, characteristic chaparral shrubs are evergreen, broad sclerophylls. They have deep, extensive root systems and resprout vigorously after fire. The nonsprouting shrubs produce abundant seed which germinates rapidly after fire. Following a fire, characteristic shrubs such as yerba-santa and manzanita and herbaceous cover dominate the plant community but are typically of short duration as resprouting shrubs slowly regain dominance.

RIM AREA HABITATS



Vegetation Association	Shortgrass Grassland	Pinyon-Juniper Woodland		Ponderosa Pine Forest			Pine-Fir Forest			Ponderosa Pine Forest			Pinyon-Juniper Woodland			Grassland	
Plant Community		Pinyon-Juniper	Cottonwood Willow	Ponderosa Pine	Pine-Bunchgrass Park	Pine-Fir	Mtn. Meadow	Fir-Aspen	Maple-Alder	Ponderosa Pine	Ponderosa Pine Emory Oak	Oak - Sycamore	P-J Shrub	Cottonwood Willow	Chaparral	Juniper Oak	Desert Grassland
Dominant Vegetation	Blue Grama Galleta Sand Dropseed Fleabane Winterfat Wolfberry Pinyon	Pinyon One-Seed Juniper Ponderosa Pine Gambel Oak Skunk Bush Rabbit Brush Fringed Sage	Narrowleaf Cottonwood Goodingwillow Arizona Walnut Gambeloak Canyon Grape Water Birch	Ponderosa Pine Gambel Oak Alligator Juniper Fendler Ceanothus Squirrel Tail Lupine Rabbit Brush New Mexican Locust Mtn. Muhly Arizona Fescue Mutton Grass Golden Pea	Arizona Fescue Mtn. Muhly Pine Dropseed Squirrel Tail Mutton Grass Western Yarrow Ponderosa Pine Fendler Ceanothus Skunk Bush Gambel Oak Geranium Red & Yellow Pea	Ponderosa Pine Douglas Fir Gambel Oak White Fir Oregon Grape Arizona Fescue	Tufted Hairgrass Timothy Redtop Sedges Rushes Clover Dandelion	Douglas Fir Aspen White Fir Maple Strawberry Honeysuckle Bracken Fern	Rocky Mtn. Maple Thinleaf Alder Honeysuckle Rose Bromegrass	Ponderosa Pine Gambel Oak Chihuahua Pine Alligator Juniper Fendler's Ceanothus Skunk Bush Squirrel Tail Lupine Cercocarpus Arizona White Oak	Ponderosa Pine Emory Oak Arizona White Oak Pinyon Alligator Juniper Gambel Oak Cercocarpus New Mexican Locust Manzanita Agave Buckthorn Fleabane Pine Dropseed Long-tongue Muhly	Arizona Sycamore Arizona Walnut Arizona White Oak Fremont Cottonwood Arizona Alder Arizona Ash Sugar Sumac Seepwillow Coyote Willow Algerita Honeysuckle Canyon Grape	Utah Juniper Pinyon Ponderosa Pine Shrub Live Oak Manzanita Beargrass	Narrowleaf Cottonwood Goodingwillow Walnut Canyon Grape Kentucky Bluegrass	Shrub Live Oak Sugar Sumac Skunk Bush Manzanita Desert Ceanothus Silktassel Wait-a-Bit	Alligator Juniper White Oak Emory Oak Shrub Live Oak Blue Grama Plains Lovegrass Golden Eye Deerhorn Cholla	Side-oats Grama Hairy Grama Black Grama Curlymesquite Snakeweed Mesquite
Mammals	Pronghorn Blacktail Jackrabbit Desert Cottontail Gray Fox Coyote	Mule Deer Desert Cottontail Kit Fox Spotted Skunk Deer Mouse Rock Pocket Mouse	Raccoon Hognosed Skunk Rock Squirrel	Elk Muledeer Abert's Squirrel Golden Mantled Squirrel Porcupine Mountain Lion	Elk Muledeer Badger Valley Pocket Gopher Bobcat Coyote	Elk Muledeer Black Bear Least Chipmunk Longtail Weasel Red Squirrel	Elk Pocket Gopher Deermouse Mexican Vole	Elk Black Bear Lion Red Squirrel	Elk Black Bear Raccoon Valley Pocket Gopher Whitetail Deer	Whitetail Deer Mule Deer Cottontail Rabbit Porcupine Striped Skunk Rock Squirrel Gray Fox	Black Bear Mule Deer White-throated Pack Rat Bobcat Whitetail Deer Hognosed Skunk	Arizona Gray Squirrel Raccoon Hognosed Skunk Black Bear Whitetail Deer	Muledeer Ringtail Cottontail Black-tail Jackrabbit Antelope Ground-Squirrel	Raccoon Hognosed Skunk Rock Squirrel Bobcat	Whitetail Deer Muledeer Cal.Brown Bat Ringtail Raccoon Western Pipistrelle	Muledeer Whitetail Deer Gray Fox Coyote Desert Cottontail Peccary	Peccary Coyote Bobcat Desert Cottontail Ringtail Cat Mexican Freetail Bat M. Brown Bat
Birds	Meadowlark Night Hawk Horned Lark Chestnut Collared Longspur	Lark Sparrow Black Throated Gray Warbler Black-Chinned Sparrow Bush-tit Rock Wren	Western Wood Pewee Hooded Oriole Red-tailed Hawk Cassin Kingbird	Turkey Western Goshawk Mtn. Chickadee Golden Eagle Ruby Crowned Kinglet	Turkey Western Bluebird Chipping Sparrow Lazuli Bunting Pygmy Nuthatch	Western Goshawk Evening Grosbeak American Raven Spotted Owl Mountain Chickadee	Turkey Robin Pine Siskin Slate-Colored Junco	Turkey Band Tail Pigeon American Raven Stellar's Jay Spotted Owl	Zone-tailed Hawk Pygmy Owl Downy Woodpecker Western Flycatcher Red-faced Warbler	Western Bluebird Acorn Woodpecker Bandtail Pigeon Lazuli Bunting Pygmy Nuthatch Turkey	Hutton's Vireo Common Bushtit Mexican Jay Bandtail Pigeon Solitary Vireo Blue-Gray Gnatcatcher Rufous-sided Towhee	Hooded Oriole Bridled Titmouse Western Kingbird Screech Owl Cooper's Hawk Painted Redstart Great Horned Owl Dipper	Mexican Jay Rock Wren Black-chinned sparrow Bushtit	Mourning Dove Black Phoebe Western Kingbird	Scrubjay Bewick's Wren Canyon Wren Rufous-sided Towhee Black-chinned Sparrow Whippoorwill	Bushtit Chipping Sparrow Scrub Jay Solitary Vireo Acorn Woodpecker	Gambel Quail Brown Towhee Chipping Sparrow Roadrunner Gray Vireo Plainopepla Kestral Lark Sparrow
Reptiles & Amphibians	Blacktailed Rattlesnake Western Kingsnake	Bullsnake	Western Gartersnake	Short-horned Lizard Mountain Kingsnake Great Plains Skink	Blacktailed Rattlesnake Eastern Fence Lizard Mountain Kingsnake	Short-Horned Lizard Blacktailed Rattlesnake	Tiger Salamander	Eastern Fence Lizard Blacktailed Rattlesnake	Canyon Tree Frog Leopard Frog Mexican Garter Snake	Short Horned Lizard Eastern Fence Lizard Black-tailed Rattlesnake	Tree Lizard Western Garter Snake Greater Earless Lizard	Canyon Tree Frog Leopard Frog Mexican Garter Snake	Tree Lizard Gila Monster	Canyon Tree Frog Leopard Frog	Collared Lizard Banded Gecko Sriped Whipsnake Mexican Blackheaded Snake	Western Garter Snake Tree Lizard	Gila Monster Western Rattlesnake Western Whiptail

E. Wildlife and Fish

The Mogollon Rim area provides some of the most valuable and important wildlife habitat found in the State of Arizona and Southwestern region of the United States. A wide variety of animals, both game and non-game, are found in this area.

1. Big Game

a. Mule deer (Odocoileus hemionus) - The entire area is inhabited by mule deer, the most heavily hunted big game animal in the State. Their range includes mixed conifer, ponderosa pine, pinyon-juniper and chaparral vegetative types. Seasonal migrations of mule deer occur when weather conditions drive some animals from summer to winter ranges. However, resident populations occur in all vegetative types.

b. Whitetail deer (Odocoileus virginianus) - The area along the Mogollon escarpment, both above and below, encompasses the most important part of the whitetail deer habitat within the study area. This area is mixed conifer and ponderosa pine with mixed shrub and juniper understory, especially below the Rim. Seasonal migrations to lower elevations also occur here, as weather conditions dictate. An occasional glimpse of this dainty, vest pocket stag is highly esteemed by trophy hunter and non-hunter viewer alike. It appears that the whitetails may be expanding their range in that some are being found in areas where they were unreported previously and numbers are increasing in peripheral habitat types.

c. Elk (Cervus canadensis) - The native species (Merriam's elk - Cervus merriami) was extirpated in Arizona in the early 1900's. The present species was introduced to Arizona from Wyoming and is one of the most important big game animals on the Mogollon Rim. High populations of elk occur from the mixed conifer through the ponderosa pine during the summer. Heavy snow conditions move elk north into pinyon-juniper and fringe ponderosa pine and chaparral areas. Small resident herds can be found below the Rim. Blindness in elk, caused by a parasitic roundworm (Elaeophora schneideri) is a problem limiting elk numbers in the Southwest and Mogollon Rim area.

d. Black bear (Euarctos americanus) - The species is found throughout the area but are most numerous in the rough terrain just

above and below the Rim. Bear generally wander in search of food and utilize such materials as carrion, mast, berries, mushrooms, etc. as these foods become available. Heavy, dense stands of vegetation provide ideal habitat for bear along the Mogollon Rim.

e. Mountain Lion (Felis concolor)-Because of their territorial nature, especially in males, mountian lion populations generally remain small and static. There will be slight fluctua- with food supply, however. The best habitat for lion occurs just above and below the rim and in the major canyons. Lions range over the entire area.

f. Turkey (Meleagris gallopavo)-This species is found over the entire area but is most common in the ponderosa pine type. They nest and summer from the mixed conifer through the ponderosa pine. Individual family groups (hens and poults) will follow available food and water supplies, utilizing green forage, insects, and other plant material. Winter migrations into lower pinyon-juniper and ponderosa pine fringe areas occur when adverse snow conditions are present or when adequate feed is not available at the higher elevations. The birds then return to the pine and mixed conifer types to breed in the spring.

g. Pronghorn (Antilocapra americana)-The American pronghorn or antelope occurs in small numbers in the northern portion of the study area. These animals are primarily found in the open grasslands to the north but are occasionally seen in the pinyon-juniper and ponderosa pine zones.

h. Collared Peccary (Pecari tajacu)-This species is primarily found below the Mogollon Rim in semi-arid areas. Herds will move into the chaparral, pinyon-juniper and ponderosa pine types during mild winters. There are isolated groups of javelina above the Rim but these populations are small. Cacti, herbaceous forage and mast comprise the bulk of the diet.

2. Small Game

a. Cottontail Rabbits - Three species of rabbits can be found in the area. These are: a) Sylvilagus floridanus - eastern cottontail, b) S. nuttallii - Mountain cottontail, c) S. audobonii- desert cottontail. The desert cottontail inhabits the entire area. The eastern and Mountain cottontail occur in small

numbers above the Rim. These animals occur throughout the area in all vegetative types and are important as a prey species for carnivores and raptors as well as the hunter.

b. Tree squirrels - Three species are found in the study area. These are (1) Sciurus aberti - tassel-eared squirrel, (2) S. arizonensis - Arizona gray squirrel, and (3) Tamiasciurus hudsonicus - red squirrel. The tassel-eared squirrel inhabits mainly the ponderosa pine type. The Arizona gray squirrel occupies hardwood areas of walnut, sycamore and tree oak and therefore only occurs in isolated pockets or along stream courses where these plants are found. The red squirrel occurs in the mixed conifer type. All three species are hunted; however, the tassel-eared squirrel is the most important of the three species.

c. Bandtail pigeon (Columba fasciata)-These birds nest and summer in the ponderosa pine type, mainly above the rim. In the early fall adult and juvenile birds will concentrate in local feeding areas. Mast, pine seeds and berries provide the bulk of fall diets. Pigeons are also attracted to salt licks where they consume salt. Flocks will linger in the pinyon-juniper and chaparral areas below the Rim during the fall, depending on the availability of food, before migrating south into Mexico and Central America for the winter. Dead snags provide important habitat for bandtail pigeons.

d. Mourning dove (Zenaidura macroura)-This species nests and summers in all vegetative zones along the Mogollon Rim. Populations fluctuate at higher elevations when available feed is limited in the desert areas of southern Arizona. During the fall and early spring, migrating birds that summer farther north will pass through the area and spend some time feeding and resting along the Rim. Duration of stay is dictated by weather and food supply.

e. Gambel Quail (Lophortyx gambelii)-This species is limited to the lower fringes of the pinyon-juniper and chaparral and contribute little to the huntable fauna of the Mogollon Rim area. Some increase in Gambel quail appears to have taken place where type conversion of pinyon-juniper has been done.

f. Waterfowl (ducks, geese, etc.)-Natural marsh and lake areas above the Rim are limited but do provide some nesting areas for waterfowl. These areas, along with the man-made lakes and stock tanks in the area, provide resting and feeding areas for fall and spring migrants. Species

one can find include mallards, pintails, shovelers, teal, redheads, canvas backs, ruddys, coots, gadwalls, and occasionally Canadian geese.

3. Non-Game Animals

a. Songbirds - The Mogollon Rim area provides a wide variety of habitat types which support over 100 different species of songbirds. Most are migratory and found in the area during spring and summer.

b. Predatory Animals - Included in this group are such animals as the coyote, bobcat, gray fox, kit fox, raccoon, ringtail cat, chula, striped skunk, hooded skunk, spotted skunk and long-tailed weasel. Each of these animals can be found in varying numbers throughout the study area and are an integral part of the total faunal ecosystem of the Mogollon Rim.

c. Small Mammals (Primarily rodents) - A wide variety of animals fall within this general calssification. They are an important part of the food chain. Examples within this group include the vagrant shrew, big brown bat, black-tailed jackrabbit, rock squirrel, cliff chipmunk, valley pocket gopher, beaver, northern grasshopper mouse, western harvest mouse, canyon mouse, deer mouse, brush mouse, pinyon mouse, Mexican woodrat, Mexican vole, house mouse and porcupine.

d. Birds of Prey - The eagles, hawks, and owls play an important part, also, in the total wildlife spectrum of the Mogollon Rim. Both the American bald eagle and the golden eagle can be found in the area. Hawks include the goshawk, Cooper's hawk, red-tailed hawk, zone-tailed hawk, black hawk, and marsh hawk. The owls include the screech owl, great horned owl, long-eared owl, spotted owl, short-eared owl, saw-whet owl and burrowing owl. The fish hawk or osprey can also be found here as can the prairie falcon, peregrine falcon, sparrow hawk and turkey vulture.

e. Rare or Endangered - Several species in this category inhabit the area. These species are less tolerant to major habitat modifications and should be given special considerations in any habitat management program in the Mogollon Rim area. Special management requirements are necessary to insure these animals are preserved. These animals are:

1) Southern bald eagle (Haliaeetus leucocephlalus)-Endangered

2) Peregrine falcon (Falco peregrinus)-Endangered

3) Spotted bat (Euderma maculata)-Rare

4) Little Colorado spinedace (Lepidomeda vittata)-Rare

f. Reptiles and Amphibians - Species in these groups are represented by the following: tiger salamander, western spadefoot, Woodhouse's toad, Southwestern toad, Arizona treefrog, Canyon treefrog, chorus frog, leopard frog, Gila monster, banded gecko, collared lizard, eastern fence lizard, tree lizard, short-horned lizard, many-lined skink, plateau whiptail, narrow-headed water snake, western garter snake, gopher snake, Sonora mountain kingsnake, night snake, coral snake, black-tailed rattlesnake, and western rattlesnake.

Total habitat management should consider animals in this group. Future management will as we become more aware of the total effect of various land management practices on the resident fauna.

4. Delicate Habitat Types - Only through proper integrated land management will a number of existing key habitat types be preserved and maintained in the area. Special management considerations are sometimes needed to preserve and enhance these fragile areas. These habitats are extremely important in that they contribute directly or indirectly to the welfare of the rare or endangered fauna. The continued disappearance and destruction of these habitats will only aggravate the problem of management of rare and endangered wildlife. Examples of these special habitats are:

a. Riparian - These streamside areas are limited in number and acreage but are extremely important to several animal groups, especially songbirds and fish. Proper watershed management and domestic livestock management are essential to maintain the integrity of these riparian areas. Any activity that alters fragile riparian habitat can only be a detriment to the resident wildlife.

b. Wet Meadow - This type includes the wet meadow or cienega and the wet stringer bottoms that are extremely limited in the Mogollon Rim area. These areas are extremely important for a number of reasons: (1) production of invertebrate and vegetable matter used by larger vertebrate forms, (2) provide a special habitat type for peripheral or low density wildlife species, and (3) provides a water source for all forms of

animal life. Mismanagement activities can destroy these areas and alter them to the point of uselessness for wildlife unless special consideration is given them in land use planning.

c. Old Burns - This habitat modification provides diversity in the habitat as plant succession advances through the various seral stages toward the climax type. Improved wildlife habitat is produced. This greater plant diversity provides a greater array of food and cover which enhances the area for wildlife. Good wildlife habitat is related to plant species diversity ahd burned areas help provide this.

d. Aspen Stands - This habitat type is also extremely limited and very important on the Mogollon Rim. A strict fire suppression policy can reduce this habitat type by not allowing fire to open forested areas. Fire as a management tool may be necessary to perpetuate this habitat type. Clearcutting in small blocks can also be used as a management tool to allow aspen regeneration.

5. Sport Fishing - Fishing is another wildlife resource that the Mogollon Rim area provides. Man-made lakes such as Blue Ridge, Knoll, Bear Canyon, Willow Springs, Black Canyon, and Chevelon Canyon are all stocked by the Arizona Game and Fish Department, primarily with rainbow trout and to a lesser degree with brown trout, brook trout, Arizona native trout, coho salmon, and grayling. Many streams such as East Clear, Willow, Chevelon, East Verde, Tonto, Horton, Christopher, Canyon, Haigler, Dude, and Pine are also stocked by the Department to provide many hours of recreation for the public. Native fishes are another important element of the fauna of the Mogollon Rim. Included here are such species as the Colorado chub, speckled dace, longfin dace, Little Colorado spinedace, and southwestern plains killifish. Some of these waters could be managed for native fish species under more intensive land management in the future.

   Two State fish hatcheries are within the study area, located on Tonto Creek and Canyon Creek, both below the Rim. Both provide cold water fish species for the fishable waters in the area on a put-and-take basis.

In summary, the Mogollon Rim area is probably THE most important wildlife area in the State in that it provides a wide variety of vegetative types and associated animal species. The area has easy access and is in close proximity to the Phoenix area. Human activities are available on a year-round basis. Hazards from overdevelopment and encroachment of residents and recreationists can and will have a lasting effect on the wildlife.

F. Special Amenities

Much of the character of the Rim area cannot be expressed altogether in a physical description of the land and its features. The aesthetic qualities, the way-of-life of its inhabitants and visitors, the historic and cultural associations, and other special amenities are all a part of making this a distinctive area that can be separated from much of the rest of Arizona.

Visual Qualities - Many scenic features are found within the Rim Area, ranging from large unbroken stands of pinyon and juniper, to the rocky scarp of the Mogollon Rim itself. Feature articles extolling the scenic qualities of many spots within the Rim area have appeared in the Arizona Highways magazine a number of times. Numerous landforms, and a varied vegetation, combine to form a number of unique scenic values.

Unique Environments - Streamside areas both above and below the Rim contain unique cool shaded environments, most of them located in rugged canyons edged by sculpted rock outcroppings. The rich variety of plant and animal life forms, as well as the cool waterside environment, make these spots outstanding attractions.

Aspen groves, while not particularly extensive, provide splashes of color in the fall, as do the many Gambel oaks. Below the Rim live oak species provide another period of color in the spring.

Along the Rim, a number of small, marshy lakes, scattered sinkholes, and occasional stringers of open meadow provide islands of differing habitat within the area. Occasional stringers of Colorado blue spruce, notably in Willow Creek, are unique, to be found in only three other areas in Arizona. One of the northern-most occurrences of Chihuahua pine in the state is found near Gordon Canyon, in a small area. Below the Rim, near Pine, are many stringers of Arizona cypress, a species unique to central Arizona.

Wilderness and Natural Areas - While no classified wilderness areas are within the study area, one roadless area of at least 5,000 acres exists within Chevelon Canyon. Many smaller areas, particularly along the Rim scarp and in the deeper canyons are undisturbed (except for protection from fire and limited grazing). Several of these are designated as special management units in existing Multiple Use Plans. No Research Natural Areas are presently classified within the study area.

Air Quality - The absence of any major pollutant sources within or near the study area, makes this an area of above average air quality. Except for local temperature inversions associated with small closed basins, air transport and mixing are generally good throughout the area, which is generally less affected by large scale stagnation events than the large basins to the north and south.

Intermittent pollutant sources, such as from wildfires or slash burning have caused diminished air quality for short periods. During dry seasons, heavily travelled dirt and gravel roads are locally annoying sources of dust. In many cases, vegetation on both sides of a road may be coated with dust.

Way-of-Life - Much of the character that distinguishes the Rim Area from other parts of the world has to do with the way-of-life of its inhabitants, and those who visit and use the area. Individually, most of these characteristics are not necessarily unique, there may be similar kinds of people doing and thinking similar things in many parts of the country. Collectively, however, the kinds of people and their activities can put their stamp on an area just as surely as a unique feature of the landscape. This study cannot pretend to look exhaustively at the culture of the area, however, it may be worthwhile to point out a few obvious social characteristics which can be considered in allocating land uses.

There is still a substantial segment of people in the area who were born to a rural way-of-life closely associated with cattle ranching. While they may no longer own or work with cattle, their familiarity with this activity tends to flavor many of their attitudes, language, and activities. Local rodeos in many communities are often recreation for participants and local spectators, rather than being large regional money-making events.

There is a frontier type attitude of self-reliance. This is probably exemplified best by the many places of business and homes which were constructed personally by the owners, some over long periods of time. This independent spirit is also characterized in many residents' attitudes towards zoning, construction codes, sewer districts, and other kinds of government management of what they feel capable of doing themselves, using their own resources. A surprisingly large portion of homes, for example, are heated with wood, involving considerable effort to cut and haul, and the daily chore of starting and tending fires in wood stoves and fireplaces.

Outdoor work and activities are second nature to many, and it is not uncommon for schools to be empty and businesses to be closed during certain hunting seasons. Most are willing to accept prim-

itive roads and facilities as part of the environment, and the idea of getting somewhere faster, or with less effort, is not always important. There is less emphasis on the recreational aspect of many outdoor activities, and more on the practical, for example hunting is a means of obtaining meat, trips to the woods to gather chokecherries or wild grapes are intended to reduce grocery bills, and rock hounding to some may be accompanied by a real hope of finding a valuable mineral deposit. Thousands of mining claims staked in areas with only minimal evidence of mineralization are a testimony to this.

There is probably less concern with esthetics than with more practical aspects. It is not unusual to see junked cars, or machinery, or other items stored where they can be conveniently reached rather than where they can be screened from view. Preoccupation with lawns or other landscaping is at a minimum, not necessarily reflecting an attitude of neglect, but of the impracticality of tending these things on shallow soils, or with limited water supplies, or in areas with a short growing season.

"...men go forth to admire lofty mountains and broad seas, and roaring torrents, and the ocean, and the course of stars, and yet forget their own selves."

St. Augustine

III. *Fragile and Unique Resources*

III. FRAGILE AND UNIQUE RESOURCES

A characteristic of many of the values in the Rim area, is that they are fragile or unique; fragile in the sense that their character could be easily changed by accident or design, and unique in the sense that they are either not found elsewhere, or that there is very little of this value to be found. Some values are much more sensitive to change than others, and the conditions required for restoring or reestablishing them may be difficult or impossible. Other values, while subject to change, might easily be recreated. Our intention in this section is to discuss the former, rather than the latter.

A. Near-natural Areas

Relatively few areas anywhere have not been influenced in some way by man's activities. Such influences can be directly visible and immediately apparent, such as after the construction of a road, and apparent only to those with some knowledge of the particular ecosystem, such as the changes in vegetative composition which occur as a result of fire exclusion over a long period of time. That man changes nature does not automatically imply that he destroys it. This viewpoint has been well expressed by Paul Fleischman, who writes:

> "Man is part of nature. The destruction he appears to cast on nature is itself part of natural processes. Death may not be wounding, but formative - as it is in the development of the chick wing, in which the formation of a functionally adaptive organ requires the death of adjacent tissue. Man himself and other contemporary species are the products of an evolution in biological forms that was brought about by massive changes in the environment - shifts that as part of their creative force also destroyed unnumbered thousands of species." 1/

We know that many natural changes to the environment can occur over relatively short periods of time - in Arizona this is well exemplified by historic changes as a result of drought cycles. With this in mind then, we suggest that our efforts should perhaps be directed less at deploring changes to natural environments, but more toward understanding and, perhaps, guiding them. One requisite is that we attempt to identify the environments which are natural, or nearly so, and then evaluate them. Where are they? What special values are inherent to them? Are special measures needed to preserve these values?

1/ Paul Fleischman, Conservation: The Biological Fallacy, Landscape, Vol. 18, 1969.

One value of near-natural condition is as an area where scientific research of ecological processes under natural conditions can be carried out. The Forest Service cooperates with other public agencies and private organizations in identifying and designating for preservation as Research Natural Areas, representative areas of major natural plant communities, of at least 300 acres. Presently no such areas have been designated within the Rim Area, primarily because representative areas of similar plant communities have been designated elsewhere in Arizona. The Federal Committee on Research Natural Areas has identified what they consider to be gaps (vegetative types not preserved) in research natural areas on federal land. Of the types listed, K-31 Oak-juniper Woodland, and Arizona cypress are the only ones represented within the Study Area. Both of these types are known in much more extensive and representative stands in other parts of Arizona. This study has therefore not attempted to identify potential research natural areas.

Smaller areas containing specimen plants, plant groups or plant communities of unusual ecological interest may be protected as botanical areas. Several such areas have been identified and designated by District Rangers in the Rim area as management units in their Multiple Use Plans. Such areas often contain facilities such as trails, interpretive signs and parking lots necessary for public use and enjoyment, as botanical areas are frequently of educational interest. As new areas are located, they can be protected by proper designation. It was not felt that an inventory of additional areas with this kind of potential was feasible during this study.

Areas of land with outstanding geological formations or other evidences of the earth's development may require special management to preserve their scenic and scientific value. Within the Rim area, caves and sinkholes have been identified as the geological features most likely to be damaged. These are shown on the map of fragile and unique features.

Three streams within the Rim area have been identified as "free flowing" and therefore meeting the minimum criteria for inclusion in the National Wild and Scenic Rivers System. This system preserves selected rivers in three classes (wild, scenic and recreational) with their immediate environments, in a free flowing condition. Rivers selected should possess outstanding remarkable scenic, recreational, geologic, fish and wildlife, historic, cultural or similar values. The three streams identified, Tonto Creek, Chevelon Creek, and the East Verde River are not now being considered for inclusion in the Wild and Scenic Rivers System, but could, because

of other values, be considered for further protection as water influence zones or special management units.

Areas along streams, and around lakes or reservoirs where existing or anticipated outdoor recreational use is planned, are designated as water influence zones. Areas within such zones not used for locating facilities needed for recreational use, are managed with special emphasis on natural beauty. Uses which change natural conditions are not necessarily prohibited, but are so modified that they are unobtrusive under close scrutiny, and in this sense, a near-natural condition is often maintained. To most observers, such areas are "natural," and fulfill the needs of many people desiring undisturbed conditions, who are not aware of the moderate ecologic changes occurring over time. There are many such areas designed within the Rim Study Area, in fact, along virtually every free flowing stream and around every reservoir where there is access for recreationists. An inventory of all aquatic habitat areas is included in the Appendix, and should be reviewed by each District for possible additions of recreationally important water areas to the Water Influence Zone.

Travel influence zones have a similar purpose, except that they are oriented around travel routes and developed recreation sites. Much of this area is also managed to maintain near-natural conditions, with emphasis on aesthetic considerations. Within the Rim area, approximately 10% of the land area is presently included within this zone.

Because of excessive slope, rockiness, or topographic barriers, much of the area is inaccessible for many resource uses. Such areas have remained roadless, and except for grazing and some recreational use (primarily hunting), there is little evidence of man's activities, making these areas essentially natural in character. These areas have not been mapped for this study, but are estimated to comprise about 17% of the land area. A separate study to identify roadless areas of at least 5,000 acres for further study as possible additions to the wilderness system, has located two areas, Chevelon and Leonard Canyons, within the Rim Area. These areas have not been recommended for further study, however, based on existing intrusions, and intermingled ownerships. 2/ Many people think of wilderness designation as the only means of "preserving" natural areas, when in fact many such areas are already designated and managed for natural values. Chevelon Canyon is an example, as it has been designated for several years as a management unit which prohibits road construction, timber harvest, grazing and motorized vehicles. The management emphasis is presently for water quality and aesthetics.

2/ USDA, Forest Service, Draft Environmental Statement, Selection of Proposed New Study Areas from Roadless and Undeveloped Areas Within the National Forests, January 1973.

The Chief of the Forest Service has declared that environmental impact statements will be filed under the National Environmental Policy Act before any action is taken which would change the wilderness character of any of the inventoried roadless areas.

B. Archeologic Sites

The prehistoric cultures of this area are evidenced by innumerable archeologic remains. Significant clusters of sites occur, mostly near water, in a zone of favorable climate below the edges of the ponderosa pine type. Investigations of this rich archeologic resource have not been intensive to date, and the cultural prehistory of the area is not well understood, although sites associated with the prehistoric Desert, Sinagua, Mogollon, Anasazi and Salado cultures have been identified.

The relative density of archeologic sites occurring within the Rim Area is shown on the map of fragile and unique features in the Appendix. The following criteria were used in establishing the three relative densities shown on the map.

High - Fifty or more sites per square mile. In each section there are probably one or more major habitation sites, several smaller habitation sites, several major field systems (defined by terraces and/or irrigation channels), and a variety of limited activity sites.

Moderate - Twenty-five to fifty sites per square mile. Major habitation sites are infrequent, but there are important habitation and non-habitation units.

Low - Zero to twenty-five sites per square mile.

For obvious reasons, our map does not show individual sites. The greatest detriments to the archeologic resource are vandalism and illicit collecting. There is hardly a known major site that has not been damaged to some degree, from a simple picking up of surface artifacts by "pot hunters" to wholesale digging, or, in some cases, blasting or bulldozing for subsurface artifacts. The mere collection of surface artifacts reduces the scientific and educational value of the site, and excavation can completely obliterate the few clues to prehistory that may be present. Stolen artifacts are readily saleable, as almost everyone is fascinated by them, and a substantial black market exists.

C. Historic Sites

Historic sites and areas contain interesting details of the life and activities of the past. Some sites may have significance as the lo-

cation of some historic event, but with no physical evidence or remnant visible at the site. Other sites may have something in evidence, such as a building, a road or trail, or a cemetery which can show the activity which occurred at that location.

Part of the difficulty in identifying historic sites lies in assigning the proper degree of significance to the site, or to the remnant which may be there. While interesting, obviously every old cabin, road or mine is not always "historic." In addition, if they cannot be located exactly, there is probably little value in attempting to preserve a site. A common problem is in determining what the condition and appearance of a site was at the time of historic interest. There may be little value to preserving an area if it does not reflect the true atmosphere of the place in reconstructing in the visitor's mind the actual scenes and activities which occurred there. A question which always arises is, what features of the site need, or are worth, preserving? Quite often, a historical inaccuracy is perpetuated, simply because not enough research is done to assure that an event in fact occurred at the site in question, or that the remnant (cabin, road, etc.) is in fact the one of historical interest.

There are only four sites within the Rim Area which are presently listed[3/] as having a potential for inclusion in the National Register of Historic Places. There are no sites within the area, which are listed on the Register. Generally, this lack of mention in official lists of historic sites can be construed, perhaps, as a lack of important historic events in the area. Even more probable, is the lack of historical data. There were no military posts in the area where records were kept, no early day explorers recorded any trips across this area, and none of the early settlements had newspapers. As a result, most of what is known about the area's history has to do with early settlers whose descendents are still living here.

A comprehensive historical research of this area has not been possible as a means for locating sites worthy of preservation. The following, however, is a list of sites, and their approximate locations, which may merit further research, and possible preservation. These sites are shown on the map of Fragile and Unique Resources.

3/ Arizona State Parks Department
An Interim Plan for Historic Preservation in Arizona,
August 1970

	Site	Approx. Location	Apparent Significance
1.	Wilford	Black Canyon	Site of early Mormon settlement (1883-85) and early Ranger Station.
2.	Stott, Scott, & Wilson Graves	Black Canyon	Graves of three men lynched during Pleasant Valley War period.
3.	Mormon Crossing	Lower Chevelon	Possible location of early Mormon settlement (1879) called "Valley of Agalon."
4.	Al Fulton Grave	Lake No. 1	Grave of cowboy murdered during Pleasant Valley War.
5.	Ramer Road	Nelson Point	Early trail and wagon road connecting Pleasant Valley area with areas above Rim. Site of trail drives. Partly on Indian Reservation.
6.	Double Cabin	Gentry Canyon	Site of early homestead. Possibly site of killing of cattle rustlers by early ranger.
7.	Beaver Park	Beaver Canyon	Possibly location of cabin used as early ranger station, and used by Zane Grey in 1920's.
8.	Battleground	Battleground Ridge	Site of Battle of Big Dry Wash. Presently marked with a monument.
9.	Pinchot Cabin	Houston Draw	Early ranger station, camp site during visit by Gifford Pinchot in 1905.
10.	Buck Springs	Buck Springs Canyon	Early Ranger Station.
11.	Dutch Joe Look-out	Chevelon	One of few remaining wooden look-out towers (on private land).
12.	Cabin Draw Corral	Creswell Tank	Site of release of elk in 1913, replacing extinct Merriam's elk, and basis for elk herd in that area today.

13.	R.R. Tunnel	E. Verde	Site of beginning of tunnel for proposed Mineral Belt RR, never completed (1885).
14.	E. Verde Trail	Washington Park	Early trail over Rim, followed in Battle of Big Dry Wash.
15.	Gregg Grave	Diamond Point Summer Homes	Apparent date (1847?) on grave marker discovered in 1960's predates any known white visitors to area.
16.	Crook's Trail	Along Rim	Trail located during period General George Crook commanded Army in Arizona, connecting Camp Verde and Fort Apache.
17.	Moreno Grave	Rim Road	Grave of soldier, who apparently died along trail (1887). Stone placed by family during 1960's.
18.	General Springs	Rim Road	Supposedly General Crook had a narrow escape from Apaches while camped here.
19.	Red Rock CCC	Control Road	Site of a CCC Camp during 1930's. Experiences by many youths in this program are basis for much of the interest and knowledge about conservation today.
20.	Indian Garden CCC	Highway 260	Site of a camp. Monument by men can be seen from highway.
21.	Dude Creek CCC	Upper E. Verde River	Site of a camp.

Relatively little is known about many of these sites. At most of them, little remains to be seen that is directly associated with an event or early day activity. The list is not proof that any of these sites are significant, but merely suggestions for further research, and consideration for either preservation, or marking. Historians may wish to supply the complete story for some of them.

Of the sites listed, probably none holds as much interest at the moment as General Crook's trail, in view of proposals from time

to time to make improvements to the Rim Road, which follows much of the original alignment of this trail. Concern is expressed for preservation of the original road, of which short stretches remain to one side or the other of the present existing gravel road. In addition to these actual ruts, a few mile-post markers remain, scribed in barked faces of living trees. Along most of the route, the exact alignment of the original wagon road is not known, and successive realignments of the road over the last 100 years have created several choices - which is the real one? In other areas, skid trails and spur roads used during logging further confuse the issue.

To many people, the existing gravel road is Crook's Trail, just as Highway 66 is Beale's Road, regardless of the actual road surface and alignment, and their hope is to preserve it as is. To others, the atmosphere and historic scenes of the original trail users can be preserved simply by being careful that further realignments and surface improvements needed for safety, dust, and erosion control are done tastefully, and with regard for the leisurely pace of travel in the old days. At the other extreme, are advocates of complete restoration of the original trail, negotiable only by hikers, horsemen and wagons. A further variation of this last alternative is to build a new road, as needed for motor vehicles, at some other (unspecified) location.

No doubt many other sites of historic interest could be uncovered by research. Many skirmishes between the Army and hostile Indians are recorded, but the sites never searched out. Many interesting incidents have been recorded about the life of early settlers and during the Pleasant Valley War, but few of the sites marked. Homes of early settlers (located on private land) exist throughout the area, some in excellent conditon. Some effort is needed to dig out the story of more of these, and preserve them for the future.

"If people understood that technology is the creation of man, therefore subject to human control, they would demand that it be used to produce maximum benefit and do minimum harm to individuals and to the values that make for civilized living."

Admiral Hyman Rickover, 1966

IV. *Demand for Resource Products and Values*

IV. DEMAND FOR RESOURCE PRODUCTS AND VALUES

In this study we are interested in looking at various alternative methods of managing the resource products and uses in the Mogollon Rim area. In order to measure the effect of each or any alternative, we must have some idea or measurement of the demand for each resource product or use thereof.

Demand is defined as the various quantities of a product or use which consumers will purchase at all possible alternative prices (other things being equal). The quantity which consumers will purchase will be affected by the price of the product or use, consumers' tastes and preferences, the number of consumers under consideration, consumer income, the prices of related products or uses, the range of products or uses available to consumers, and other similar factors.

From an economic standpoint, the supply of each resource product or use must also be known. Supply is defined as the various quantities of a product or use which sellers will sell at all possible alternative prices (other things being equal).

Resource policy in the Forest Service has traditionally been concerned with the planning of resource use from the supply side of the economic supply-demand equation. Supply decisions regarding use of the National Forests in the past were rather uncomplicated. With the relative abundance of resources, scarcity was no problem. Consequently, the choice among alternative uses was not a significant aspect of policy. Rather, the costs of extraction or utilization were controlling. The public incurred little or no out-of-pocket cost in making supplies available.

Times have changed. The importance of alternative uses, especially amenity values, and increasing resource scarcity require a change from supply or allocation policies based on simple physical characteristics of resources to use of economic criteria. Actual production or supply decisions must consider market conditions, including both economic demand and factors affecting the economic feasibility of supply.

On the National Forests, the raw, natural resources are combined with other resources, capital and labor, to produce more desirable forms of output. The National Forests are engaged in producing not only traditional forms of output such as timber, livestock forage, and water but also socially oriented outputs such as recreation, fish and wildlife, and a high quality environment. All of these potential outputs require production-output decisions involving the expenditure of other productive resources.

If production and use of the natural resources on National Forests are to be economically efficient, we must recognize the variance in both demand conditions and supply factors within individual resource markets. It would not be economically feasible to develop or utilize all physical supplies without regard for the costs involved. To do so would undoubtedly result in wasteful expenditure of equally scarce resources-capital and labor. Demand for a particular resource or use should not be interpreted independent of the alternative opportunities for using those same resources. It is the relative value of alternative uses, rather than the absolute value of any single use, that determines the economically efficient allocation of resources. Further discussion of relative values which should be considered is in Chapter VII.

Most National Forest output decisions are of an incremental nature rather than all-or-nothing choices. In most instances, the choice to be made is whether additional increments of particular resources or uses are economically feasible, considering both existing supply and alternative sources of meeting existing demand. Feasibility of increment changes in output is largely dependent on specific market circumstances. In making such decisions, we must know (1) what the existing supply is, (2) what the demand on that supply is likely to be, (3) what the true costs of incremental additions to supply are (including opportunity costs), and (4) what alternative sources of supply are potentially available.

In order to measure the effect of any given alternative we must identify the changes from the base proposal or current situation. These changes are both physical and economic. This section is concerned with the economic effects. In the subsections which follow, we will attempt to show the value of the resource to the user and the economic impact of use of the resource in the multi-objective terms of National Economic Development (NED) and Regional Development (RD). 1/ In addition, we have included a short discussion of some of the factors which seem to affect demand in this area.

1/ The Water Resource Council has defined a set of three national objectives, referred to as multi-objectives, for use in water and land resource planning.

(1) National Economic Development (NED) - Increase the value of the Nation's output of goods and services and improve national economic efficiency.

(2) Environmental Quality (EQ) - Enhance by management, conservation preservation, creation, restoration, or improvement of the quality of certain natural and cultural resources and ecological systems.

(3) Regional Development (RD) - Enhance through increases in a Region's income, increases in employment, and improvements in its economic base, environment, quality of life, and other specified components of the Regional objective.

A. Timber

Average annual timber cut from the Mogollon Rim Planning Area is estimated to be 65.1 MMBF (this is 15% of lumber cut in Arizona) 2/ The following shows the mill destination of the timber and the proportion of the mill's capacity furnished from the study area.

Location	Estim. Study Area Cut	Approx. % of Mill Capacity
Payson	7.6 MMBF	63.3
Flagstaff	12.5 "	18.9
Winslow	24.0 "	80.0
Heber	12.0 "	80.0
McNary	9.0 "	15.0
Total	65.1 "	35.6

A look at the table shows that an alternative to eliminate timber harvest in the study area would most probably force the mills at Payson, Heber, and Winslow to go out of business. The Payson mill is not operating at full capacity and obtains all of its supply from the study area.

Timber lands on the National Forests cannot be evaluated simply for the production of timber volumes, however. Alternative values for recreation, wildlife habitat, watershed purposes, wildernesses, minerals, and others mean that timberland production must be determined by relative rather than absolute values. While timberlands are economically used for production of timber, they are increasingly being looked upon as economically desirable for competing activities. Such situations cannot be resolved using aggregate estimates of timber needs. Rather, the incremental value of additional units of timber must be evaluated against comparable incremental units of alternative uses or outputs.

To determine economic value of timber production and harvest to the initial user (the sawmill), one must look at several value factors. The overall value is the log scale selling price of the product (finished lumber). This figure consists of variable costs, fixed costs, profit,

2/ The study area boundary does not include entire units for which timber sale accounting is normally done. Therefore, cut and value figures used in this study are only estimated.

and price paid for the raw material. The variable costs consist of all harvesting and processing expenses including felling, bucking, skidding, and loading costs in the logging operation and all costs at the mill including log yard to sawmill to greenchain operation costs and seasoning, planing, and shipping costs. Fixed costs include administrative salaries, property taxes, depreciation, and insurance. The profit margin is based on the selling price, historical experience, extent of competition, and range of operation efficiency. The cost of raw material may vary considerably with each sale and consist of slash disposal, erosion control, hauling, temporary roads, road maintenance, and price paid for stumpage. In the study area these costs in 1972 were: 3/

	Average $/MBF
Product Price	$167.33
Less: Variable Costs	67.78
Fixed Costs	19.65
Profit	21.75
Cost of Material	58.15

The incremental value of additional units of timber in the Mogollon Rim study area will thus range from the price paid or actual cash outlay for timber of $58.15 per MBF to a high of $99.55 per MBF, the maximum amount a producer (sawmill) could pay for timber and still cover his out-of-pocket (variable) costs.

The minimum amount, $58.15, is the amount the purchasing firm must pay in order to outbid its competitors. The maximum amount, $99.55, is the maximum arguable value of the product (standing timber in this case) to the purchaser. It is the maximum amount the purchaser could afford to pay in the short run and still cover his variable or out-of-pocket costs considering only expenses directly related to logging, transportation, and manufacturing of logs in a given timber sale. It represents the amount the purchaser would be willing to pay in order to keep his business operating in the short run. Although few would argue with reasonable operating costs, many might debate what constitutes reasonable profit, return on investment, or administrative salaries. 4/ In this study we will use the maximum arguable value of the product to the user. In the case of timber this is $99.55 per MBF.

3/ These figures were derived from Forest Service, Region 3 combined index operation costs of logging, transportation, and manufacturing for 1972 for ponderosa pine.

4/ O'Connell, Paul F., "Valuation of Timber, Forage, and Water From National Forest Lands," The Annals of Regional Science, Dec., 1972.

It is important to note here that harvest costs will go up and down, also, according to constraints placed on harvesting activity, i. e., more careful harvesting is more costly. If the harvest costs become too high because of such things as environmental protection measures, aesthetic demands, etc., the stumpage value could be reduced to zero or become negative. In these cases, there would be no sale. In such cases, the only time they would again be considered is if demand rises such as to significantly raise the retail market value of lumber or new technology provides for reduced harvest costs.

The impact of a change in timber harvest on the National Economic Development objective would be the maximum arguable value of the resource, in this case the $99.55 per MBF. The impact on the Regional economy includes the maximum resource value of $99.55; the cost of labor used in processing from stumpage to finished product (this labor figure is around $48.00 per MBF); and the indirect and induced effects of the change in quantity produced. The direct effect includes:

$99.55 resource value
48.00 labor
$147.55 direct benefit to Region (State of Arizona)

The indirect and induced effects however apply only to that portion of product that remains or is sold within the Region. It is estimated that only 21 percent of timber cut and processed in Arizona is sold within Arizona. Thus 21 percent of the original Regional resource value, $147.55, is $30.99. Using data from the Lower Colorado River Basin, 5/ we find that for each dollar of sale within Arizona from the lumber and wood products industry an additional $.38 is generated within the State. Likewise, an additional $.80 is induced. 6/ Thus the total amount of indirect and induced effects from a change in timber sale can be found by multiplying $.38+.80=1.18 times the $30.99 direct value that remains in the Region. This amounts to $36.57.

$147.55 total direct benefit
36.57 indirect and induced benefit
$184.12 total benefit to RD per MBF

So the total effect of a change in sale or harvest of timber in the Mogollon Rim study area will result in $99.55 per MBF National Economic Development benefit and $184.12 per MBF Regional Development benefit. This represents new income generated for NED and RD for each actual change in MBF of timber harvest.

5/ Lower Colorado Region Comprehensive Framework Study, Supplement to Appendix IV, The Economic Base and Projects for 1980, 2000, and 2020; Economic Work Group, Lower Colorado Region, June 1971.

6/ For a discussion of indirect and induced benefits see the section on local government in Chapter V, Economic Base.

As outlined in the introduction to this chapter, many other factors can influence the range of demands for the timber resource. The following are a few which should receive consideration in making decisions affecting the supply of this resource from the Rim area:

1. There is no alternative supply of raw material for the installed lumber manufacturing capacity in Arizona other than the lands currently under commercial production. While it is true that there is a substantial acreage of productive forest land being managed for other values, it is hardly conceivable that there could be any benefit in considering the use of these areas as substitutes for lands currently producing timber crops. Virtually, all of the forest land base in Arizona is committed in some way toward either providing amenity values or the production of some kinds of commodities. Further, adjustments in lands reserved from commercial production would be reflected in consequent adjustments in Arizona's timber industry, which for a number of years has been operating near the full allowable cut from the commercial acreage. In other words, virtually all of the volume being made available is being harvested and milled.

2. Nationally, lumber prices are continuing to rise at rates that will encourage producers in Arizona to operate at their maximum capacity. These steady and substantial increases in price are likely to cause timber production to remain highly competitive with other land uses.

3. Timber producing zones within the Rim area have many locational advantages to existing mills from the standpoint of the existing transportation system, hauling costs, balanced operating seasons, and community facilities for both mill and woods workers.

4. Existing industries dependent on the Rim area are very competitive from the standpoint of having facilities and markets for most sizes and classes of material available, including increasing utilization of woods and mill wastes.

B. Range

There are 23 permittees that operate on 34 grazing allotments in the Mogollon Rim study area. Of these 23 permittees, 14 are family operations while nine are incorporated units. Eleven of the family

operators reside within the study area and two of the companies are located in the area. The other 10 permittees reside in Arizona but outside the study area boundaries.

The following table shows current use of rangeland in the area.

Number of Animals and Animal Unit Years (AUY) Grazed Under Paid Permit on National Forests Mogollon Rim Study Area, 1972

	Cattle	Yearlings	Sheep	Total
Number of head	7,731	2,300	7,400	17,431
Total AUY's	7,731	1,610	1,480	10,821
AUY's on National Forest	2,958	782	740	4,480
Percent on N. F.	38.3	48.6	50.0	41.4

The incremental value of additional units of livestock forage in the Mogollon Rim study area will be measured in terms of animal unit years. These range from a low of $9.31 per animal unit year for price paid or actual cash outlay for an animal unit year of grazing to a high of $59.00 per animal unit year, the maximum amount a rancher could pay for an animal unit year of graxing and still cover his other out-of-pocket costs. The low value ($9.31) will be revised upward as grazing fees charged are increased to fair market value. At the present time this value, if collected, would make the minimum value equal to $16.44 per animal unit year (AUY).

The maximum value of range per AUY was taken from O'Connell's study (see footnote 3) of $51.00 per AUY and increased by 15 percent to $59.00 to reflect the net increase in prices from the time of the study to current value. Using the ability to pay as the resource value for NED benefits gives $59.00 per AUY for each change in AUY in the Mogollon Rim study area.

To determine Regional Development benefits we again used the Lower Colorado River Basin study data (see footnote 4) for the indirect and induced multiplier. Since 60 percent of the cattle from the Mogollon Rim area are normally sold to feeder operations within the Region (Arizona), we can figure the multiplier for 60 percent of the original value of $59.00 or $35.40. With a multiplier of 2.59 times the $35.40, the indirect and induced effects amount to

$91.69 per AUY. This includes both income to the rancher and the feed lot. Thus for each AUY increase in grazing in the Mogollon Rim area the increased Regional net income will be $150.69. The increased income is primarily to households in the Region and includes wages, profit, cooperate returns, and State and local taxes.

An explanation of the differences in RD benefits between timber and range might be of interest to some, especially since the value of the timber resource at $99.55 is greater than that for range at $59.00. The timber resource direct benefits consist mainly of returns to land and labor. However, the indirect and induced benefits originate from only 21 percent of the direct values. With range, the direct benefits consist of returns to feed, labor, and capital. The indirect and induced benefits originate from 60 percent of the direct value since 60 percent of the beef product sold from the Mogollon Rim study area is fed in Arizona feedlots rather than being exported out of the Region. 7/

The NED benefits to range to be used in this study are $59.00 per AUY and the RD benefits are $150.69 per AUY.

Lands in the Mogollon Rim area have declined in importance as a source of forage both in absolute and relative terms. The numbers of AUM's provided from the area has declined, with a shifting of use to adjacent, more productive areas where range improvement measures have been carried out.

Grazing use is much less competitive in the market place compared with other livestock feeding sources. The demand for forage is closely linked to the livestock market, and inevitably controlled by it. Because such a small proportion of the market price is returned to range livestock operators, they have little latitude to adjust supplies in accordance with demand schedules.

Historically, the returns to capital and management in the range livestock industry have always been low. Currently, especially in Arizona, these returns are very low to negative, with the only exceptions being in the largest ranch units. For this reason, much of the value of the grazing resource must be looked at in sociologic terms as well as economic. The values of having ranch units as homes, and of ranching as a way of life for a segment of our population may have other values than as a direct economic benefit to the area. In Arizona, for example, "old west" traditions are a part of the overall outlook and way of life.

7/ This does not hold for other beef producing areas within the State of Arizona but does for the study area.

The working cowboy retains a strong hold on the imagination of young and old alike, and there may be definite social values connected with retaining these qualities on the scene. At least one study 8/ identifies a number of factors other than economic which influence the buying and owning of ranches. The fact that the median age of ranchers in Arizona is 60 years may indicate that ranching is declinint as a favored business.

Historic policies and the development of the system for allocating grazing privileges on the National Forest have developed a dependency, especially in the study area, on National Forest grazing lands for a critical portion of the feed requirement for many livestock operations. With respect to forage potential and season of use, the forage value of some private lands is highly dependent upon the complementary use of public land, and in fact cannot be maintained without it in most instances.

Another important consideration is the degree to which capital investments by ranchers are tied to National Forest land. The terms and conditions under which these investments are amortized should be considered in decisions affecting grazing use.

C. Water

Use and allocation of water resources is largely governed by legal and political institutions rather than by economic values. Nonetheless, in this study we will consider the incremental value of water due to alternative physical improvements and/or effects on water from other uses. In the study area, it is assumed that the impact of any change in quantity of water (either a decrease or an increase) will take place in the agriculture sector. The same effect holds true if there is no change in quantity of water supplied the area but there is a change in demand by some other sector in the economy. All other sectors currently are able to pay a higher price for water than agriculture and currently obtain the amount needed. If they demand more, they will get more, paying their current price. The amount of increase will be taken from the current lower priced agricultural use. The incremental value of water will vary from a low of $2.28 per acre foot, the price paid, to $10.09 per acre foot, 9/ the maximum value a user could pay and still cover his out-of-pocket costs.

8/ Smith, Arthur H., and William E. Martin, 1972 Socioeconomic behavior of cattle ranchers, with implications for rural community development in the west. Am. J. Agr. Econ., May 1972.

9/ O'Connell, Paul F. "Economics of Chaparral Management in the Southwest," Rocky Mountain Forest and Range Experimental Station, Fort Collins, Colorado.

The NED benefits for water to be used in this study will be $10.09 per acre-ft. The RD benefits will be the $10.09 times a forage and feed grain multiplier of 1.4 to give $14.00 per acre-ft. direct and indirect benefits. The induced benefits have not yet been determined.

Use of $10.09 per acre-ft. as the resource value might cause some confusion to those who know that some of this water is currently being sold for $400.00 per acre-ft. to municipal and industrial users. Following is a breakdown of the current use of water flowing from the Mogollon Rim planning area and the values of each use: 10/

Use	Ability to Pay Value Per Acre-Ft. $	Salt Verde %	Little Colo. %
Municipal and industrial	400	30.2	5.0
Vegetable and citrus fruit	300	1.2	1.2
Cotton	55	12.9	12.9
Sugar beets	50	3.0	3.0
High value feed grain crops	20	23.5	23.5
Low value feed grain crops	10	29.4	54.4
		100.0	100.0

The weighted average value of water currently flowing into the Salt Verde Basin is $141.00 per acre-ft. This includes $1.65 per acre-ft. for power generated in the Roosevelt Dam. 11/ Value of the water flowing into the Little Colorado River Basin is estimated at $44.00 per acre-ft. Again this includes $1.65 for power generation. Flow of this water into both basins has provided the possibility of reservoirs and consequently contributes significantly to recreation use. The value of recreation use, however, is not figured in the above current use values.

The question is often asked, why not use the $141.00 per acre-ft. for benefits to improvement projects? The answer is relative simple. The $141.00 value is the value of the water that is currently produced. If a project being considered will increase the quantity of water the question must be asked, who will use the increased quantity? The current situation (and in the foreseeable future) is that those users paying a higher price are receiving all the water they want. If they demand more, they will receive it and pay the same price for the additional that they pay now for that currently received. If they demand more and there is no change in total quantity of water supply, they will

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10/ See footnote 8.

11/ The $1.65 per acre-ft. for power generation was obtained from the Salt River Project.

be taking away from the lowest value user. By the same token, if the water supply is increased due to a project on the National Forests it will be used by the low value feed grain crop growers who currently pay around $2.28 per acre-ft. The resource value of this, however, is the ability to pay value of $10.09.

D. Wildlife and Fish

Analysis of demand for wildlife must recognize two types of demand values--hunting and fishing and esthetics; that is the value of being able to see or appreciate wildlife in wildland areas. Both types are difficult to identify due to the lack of empirical data. Neither is measurable in the market place.

A special study was conducted in northern Arizona to gather big game management information for 1967-1969 and some for 1970. Some indication of demand for hunting can be obtained from this study. 12/ For example, although the number of permits authorized for hunting "bull elk" in 1967 through 1969 was 786, 785, and 785 respectively, the number of applications for them increased from 652 in 1967 to 869 in 1968 and 949 in 1969.

The greatest demand for hunting in the Mogollon Rim study area is for deer. During 1967 through 1969, the number of hunters increased from 4,999 in 1967 to 5,187 in 1968, and 5,283 in 1969 even though percent success declined from 7.2 percent in 1967, 5.9 percent in 1968, and 6.0 percent in 1969.

Javelina, antelope, and bear were also hunted in the study area. In addition to the big game there are also turkey, tree squirrels, band-tail pigeons, waterfowl, lion, and cottontail rabbits. There are many songbirds in the area. Fishing is also a very important aspect in the Mogollon Rim study area.

Values have been placed on hunting and fishing using the costs that individual hunters and fishermen experience such as the license fee, cost of guns, ammunition, fishing tackle, bait, and other hunting equipment, food, lodging, and transportation. 13/ Esthetic values of wildlife are included in the recreational experience values which, again, are difficult to measure.

12/ Arizona Big Game Management Information, Project W53-20 Job Completion Reports, Project Year, May 1, 1969, to June 30, 1970. Arizona Game and Fish Commission.

13/ "Values of Hunting and Fishing in Arizona, 1965" prepared for the Arizona Game and Fish Department by William C. Davis, College of Business and Public Administration, University of Arizona, Tucson, April 1967.

The resource value of game and fish in the area ranges from $.40 to $10.55 per hunter or fisherman day, depending on the species being sought. These values are as follows:

General hunting (jackrabbits, predatory animals)	$1.11 - $6.37
Small game (doves, quail, cottontails)	.74 - 4.33
Waterfowl (ducks, geese)	.56 - 8.77
Fishing (cold water)	.40 - 7.24
Fishing (warm water)	.47 - 8.10
Big game hunting (deer, elk, bighorn sheep)	.44 - 10.55

The low value shown represents the average cost of the license or permit per hunter or fisherman day of use. This represents cost of the resource. The high value represents the total hunter or fisherman day expenditures less the variable costs involved such as lodging, additional food, ammunition, bait, public transportation and part of private transportation. These are the cash expenditures involved with the specific day of hunting and/or fishing. The high value figure would be somewhat higher if the consumer surplus value were to be added. Unfortunately, at this time this value is not known.

For purposes of this study the high value will be used to represent the value of the resource and the NED benefits. Multipliers to use in determining indirect and induced values for RD have not yet been developed.

E. Outdoor Recreation

Demand for outdoor recreation is a nebulous factor. Many of us have some concept or idea of what the demand is for certain recreational activities. However, in most cases the demand we picture is based on the concept that recreation on the National Forests is free or nearly so. This is a gross misconception. The provision or supply of recreation is not free and treating it as free leads to some real problems in the allocation of natural resources. At present the greatest proportion of recreational costs are paid by the general taxpayers. This payment is only vaguely related to actual recreation use.

On analyzing the resource allocation alternatives, the cost of providing recreational opportunities must be considered. We cannot rely on consumption projections alone in determining supply objectives. It is necessary to evaluate the feasibility of additional increments to the current supply of recreational opportunities in terms of particular benefits expected and anticipated costs of each development.

The value of recreational use to the user varies from a low of $.75 per visitor day (VD) to a high of $12.00 per VD. The low value is for a general recreation day involving primarily those activities attractive to the majority of outdoor recreationists and which generally require the development and maintenance of convenient access and adequate facilities. The high of $12.00 per VD represents a special use--summer homes. It is estimated that a family of three that has a summer home permit and has built a home on the site will spend an average of $12.00 per VD for use of the facility. This represents the fee for the permit, interest on investment of the house, and costs of operating and maintaining the home.

The Water Resources Council has developed guidelines showing general recreation visitor day values ranging from $.75 to $2.25 and specialized recreation visitor day values ranging from $2.50 to $7.00. The specialized values involve those activities for which opportunities, in general, are limited, intensity of use is low, and often may involve a large personal expense by the user. In this study Water Resources Council guidelines will be used to determine the appropriate use values. These in turn will represent the benefits to NED. Multipliers will be developed from the Lower Colorado River Basin study to determine indirect and induced values for RD benefits.

Many factors other than cost (or value) influence the choices by consumers of recreational experiences, and thereby change the amount "demanded" in ways that differ somewhat from strictly economic reactions to prices and supply. The occurrence of "fads" and changes in preferences are evident, for example, the recent boom in bicycling opportunities in the form of facilities is somewhat lacking. Technological changes can create new kinds of recreational demands very rapidly which might not be considered in planning facilities or management techniques. A good example of this is the development of off-road vehicles, which has rapidly created new demands that we are unable to cope with yet. For these (and other) reasons, it is felt that analyses of recreational demands should be based to a large extent on an examination of recreationists; their numbers, locations, preferences, and other characteristics which might influence their demand for recreational experiences. Such a study is under way for this area, but is not yet completed or available for this evaluation report.

National projections for outdoor recreation, shown in the following table, would indicate that the National Forests should consider undertaking a major program to supply recreational opportunities to meet demands. However, we must look at current recreational opportunity, determine potential increase in this opportunity and analyze increments of increased opportunity by cost of each increment. These increments should then be analyzed along with the local and Regional demand considering the costs.

National Projects for Outdoor Recreation Occasions of Participation*

	Millions of Occasions 1965	Percent Change 1965-1980	Percent Change 1965-2000
Walking for pleasure	1,030	49	151
Swimming	970	72	207
Pleasure driving	940	51	128
Playing outdoor sports or or games	929	72	216
Bicycling	467	32	84
Sightseeing	457	54	156
Picnicking	451	48	127
Fishing	322	31	78
Attending outdoor sports events	246	43	117
Boating	220	76	215
Nature walks	117	48	134
Camping	97	78	238
Horseback riding	77	44	132
Water skiing	56	121	363
Hiking	50	78	218
Attending outdoor concerts and plays	47	70	206
Total	6,476	56	160
However, recreational visits to National Forests equal	160.3	170	498

*Source: Robert S. Manthy, "Future Demands on the Public Lands - Volume III - Probable Future Demands on Public Lands - A Study Prepared for the Public Land Law Review Commission, October 1970.

F. Minerals

Existing mineral activity in the Mogollon Rim study area presently consists of one stone quarry (one-man operation) and some gravel production for road material (limited to per job basis). There are no active producing mines in the area.

The Mogollon Rim area does have potential for future discovery of mineral deposits beneath the cover of post mineral formations. In general, the area has a low priority for exploration at this time due to the inadequacy of present tools and techniques and the consequent difficulty of establishing a specific target. Exploration and production costs are too high when compared with the present market value of the minerals. However, should the market value substantially increase or new, less costly methods of production and/or exploration be developed, new mining activities would undoubtedly result.

Due to the absence of mining activity in the area at the present time and the lack of knowledge concerning future activity, no attempts were made at this time to determine resource values or impact value data. These values should be developed as sufficient data becomes available.

"Fulfillment is probably the embracing word; more fulfillment and less frustration for more human beings. We want more varied and fuller achievement in human societies, as against drabness and shrinkage. We want more enjoyment and less suffering. We want more beauty and less ugliness. We want more adventure and disciplined freedom, as against routine and slavishness. We want more knowledge, more interest, more wonder, as against ignorance and apathy."

Sir Julian Huxley

V. Economic Base

Chapter V

THE ECONOMIC BASE OF THE MOGOLLON RIM COUNTRY

by Ron S. Boster and Paul F. O'Connell[1/]

Economic impacts resulting from the management activities of federal land planning agencies such as the Forest Service are not restricted to the Government sector of the national economy. Quite the contrary, such activities have noticeable impacts on the private sector. By providing employment and recreation opportunities, federal land management agencies often significantly influence economic and social welfare.

This situation is especially important at local or regional levels. There has long been a concern about the impacts of Forest Service activities on local communities (Kaufman 1960). Although quantification of such impacts has been minimal, knowledge of the locally caused impacts resulting from land management activities and policies is imperative to effective land use planning.

Professional land managers recognize the importance of meaningful analysis prior to making land use decisions. One such analysis is the Economic Base Study (Tiebout 1962) which enables the manager to predict employment and income impacts on a given region resulting from alternative management activities before they are initiated. Three factors have helped bring economic base studies, or related studies, to the planning forefront: improved data (both in quantity and quality), improved analytical models and associated "hardware" (computers), and the shift to multi-objective planning (Water Resources Council 1971). While the first two speak for themselves, the third requires some elaboration. National economic efficiency has, since 1937, dominated the criteria for Federal public works projects, and has held a similar spot for lesser projects. The multi-objective approach upgrades two criteria, environmental quality and regional development, and makes them co-equal with national economic efficiency. The National Environmental Policy Act (NEPA PL 91-190) formally recognizes the importance of the environment by requiring Environmental Impact Statements for actions that would significantly alter the environment. Clearly, multi-objective planning requires that the decision-maker be provided with sound information about the impacts of alternative projects and policies on local or regional economies before irreversible decisions are made.

The aim of this chapter is to provide this necessary information for the Mogollon Rim Country, Arizona, by bringing together various relevant economic and demographic data into an organized statement concerning the economic infrastructure of the Rim area. To accomplish this task, a considerable amount of economic and demographic data were acquired for analysis. Most of the data were collected from published sources, the major source being the 1970 U.S. Census.

1/ Economist and Principal Economist, respectively, Rocky Mountain Forest and Range Experiment Station, Tucson, Arizona, in cooperation with the University of Arizona.

The Census divided Gila County into four census county divisions. One of these, the Tonto Division, includes everything in Gila County that is in the study area plus the area south to Roosevelt Lake. The portion of the Tonto Division outside the study area was assumed economically insignificant for this study, and was ignored.

The authors are indebted to several persons and agencies for providing data, particularly Messrs. Williams and Parmee of the University of Arizona, who have been developing human resource inventories for the Heber-Overgaard and Payson areas, respectively. Published information from the Arizona Dept. of Planning and Economic Development (DEPAD) was also used. A special study for the Forest Service, "Rural Residential Development on Private Land in the Mogollon Rim Study Area" (Thompson and Lewis 1973) proved invaluable, as did consultation from Leonard A. Lindquist, Team Leader of the comprehensive Mogollon Rim Study, who provided information on timber sales, destination of harvested timber, and mill and Forest Service employment in the study area. Considerable information was also collected with special surveys conducted within the study area by the authors. Surveys were augmented by discussions with local residents, businessmen, and community leaders in addition to interviews with many Forest Rangers stationed in the Rim area.

This chapter is organized into three main parts: the first is a brief historical and cultural perspective of the area; the economic base analysis follows the historical perspective section; the third section goes into greater detail by discussing individual communities and the important economic sectors therein.

HISTORICAL PERSPECTIVE

While previous chapters have dealt at some length with the physical and ecological characteristics of the Rim Study area, this is the appropriate place to briefly recount man's activities to the present. Brevity should not be interpreted to imply, however, that the area is less rich in cultural history than in physiographic and ecologic splendor.

There is little evidence of cultural conflict before the mid-1800's. About this time, the land belonged either to the Indians of the area or Mexico, depending on one's viewpoint. Superimposed on this ownership question was the presence of Americans (hunters, trappers, miners, and later, ranchers) who needed protection from the troublesome, and sometimes fatal, Indian attacks. Since the Mexican government was unwilling to protect the Americans, the job fell to the U. S. Army. This was no easy job; no less than 46 major camps and forts were established in the Southwest, with many in or near the Rim Study Area (e.g. Forts Verde, Tonto, Apache, Reno, Camp San Carlos).

Intertwined with the Indian problem was this country's war with Mexico and the rush for California gold (gold seekers often passed through the disputed land on their way to California). What happened to the Rim area Indians during this period and after is best dealt with in books like Bury My Heart at Wounded Knee (Brown 1970), but the crux of the history is that the Army was given the job of herding the various bands and tribes of Indians onto newly established Indian Reservations.

Many of the early settlers in the Rim area first saw the country while serving in the Army. Prospecting began in the latter half of the 1800's, but mining has never been very important in the Rim area. (There were some small gold camps near Payson during the 1870's). In the 1880's, cattle had been placed on the range throughout Arizona. Mormon pioneers settled near the present towns of Heber and Pine, and on the lower East Verde. Large cattle operations, however, were generally well south of the Mogollon Rim.

Depressed cattle markets led to overstocking of many ranges in the 1890's. A severe drought in the late 1890's caused more cattle to be moved into forested areas. By the turn of the century, most sites, even those marginally cultivable, had been homesteaded. There were no towns as such, although there were the farming communities of Gisela, Payson, Pine, and Heber.

The area was already stocked with cattle when the National Forests were established from Forest Reserves and other public lands (1905-8). Because a grazing permit system was being instituted, ranchers vied for bigger shares of the grazing pie. This led to further overgrazing.

By the 1920's, most homesteads were patented, grazing had stabilized, and much of the area had been fenced. Essentially all economic activity was subsistence farming and ranching. Some early resorts (essentially dude ranches) were at Tonto Creek and Natural Bridge, but were quite small, A few very small sawmills made lumber for local use.

The 1930's saw the first sawmills with outside markets. These mills, located in Heber and Payson, were not large operations (probably less than 10 million board-feet annually). During this decade the Bush Highway, connecting Payson to the "Valley" (Phoenix area), was completed.

Larger lumber mills became established in Overgaard and in Winslow during the 1940's, and by the late 1940's, the lumber industry was much as it is today (mills in Payson, Heber, Flagstaff, Winslow, McNary). Cutting was not up to the full allowable cut of the area because timber from outside areas, but closer to the mills, was still being cut.

The completion of the Beeline Highway (State Rt. 87, a realignment of the Bush Hwy) in the early 1950's coincided with a peaking of the timber harvest within the study area. Summer home construction and land subdividing began. Several mining claims resulted in patented lands which later became subdivisions (e.g., Forest Lakes Estates and Last Chance). Except for some manganese operations, there was little actual mining. Lake and campground facilities made inroads along the Rim. The completion of the Beeline Highway also induced moderate recreation use throughout the study area.

Harvest of roundwood for the papermill at Snowflake began in the Heber and Tonto Creek areas, and reached a peak about 1965. About this time, the first large land exchanges were completed in the Payson and Heber areas, permitting additional subdividing and land speculation. A court decision in 1959 affirmed that a large timber area (the Aztec lands) was private, and heavy cutting on this land caused mill capacity to expand (3 mills at Winslow, additions to other mills) in excess of long-range supply. When the Aztec timber was exhausted, there was a tendency to overcut the allowable cut on National Forest timber sales already under contract. Several large construction projects during this period also provided significant economic impetus (e.g., Arizona Public Service 345 K-V Powerline, Highway 87, Blue Ridge Project, the Seismological Observatory, dams at Bear Canyon, Chevelon Canyon, Knoll Lake, and Willow Springs).

By 1970, the mills had stabilized, although mill employment was cut from the levels of the previous decade. Much of the Aztec lands went into federal ownership as a result of land exchanges.

ECONOMIC BASE ANALYSIS

A common way to analyze the economic base of a community is to classify the various economic firms within the area as either "export" or "local". Demand for goods and services from an export firm depends on market forces outside the area under study whereas demand for a local firm's goods and services is derived locally. Few firms will ever be 100 percent export or 100 percent local.

A community's economy is strongly dependent upon export firms. If, for example, the Payson sawmill were the only firm in the area selling its product or service to persons (or firms) outside the area, the mill would be the community's only export firm. If the mill workers live in Payson, they will demand certain goods (e.g. food) from local merchants ("local" firms). Much of the demanded goods will be purchased by local merchants from outside wholesalers with money supplied by the mill workers. If the mill ceased to operate, what would happen to the demand for local goods and services? With no goods being produced for

export (previously, lumber from the mill), money that was used to purchase goods from the outside would soon disappear. Local merchants could not for long buy or trade only among themselves. The economy, under the above assumptions, would stagnate and die. Local firms -- those which supply goods and services to local residents -- therefore depend on and arise from the existence of export industries. In other words, the growth of local industries depends on increases in existing or new export firms. Five export industry groupings are evident in the Mogollon Rim study area: lumber, transient recreation trade, agriculture, state and federal government, and persons living on pensions or other forms or retirement income.

Due to inadequate data, employment could not be allocated directly into these five export categories. However, considerable insight into the local economic base may be obtained from a simple division of employment into either "local" or "export" (Table 1). This simple breakdown permits us to examine the interdependencies within the economy, and derive a useful employment multiplier.

A discussion of the industrial sectors in the Mogollon Rim study area follows:

Agriculture

This sector is almost entirely composed of cattle ranches, though there are a few sheep ranches and a small amount of general agriculture. Approximately 42 percent of the grazing is on National Forest lands (4,518 animal unit years (AUY) out of 10,835 AUY). This grazing is done by 23 permittees on 34 allotments. Essentially all of the cattle and yearlings are exported directly out of the Rim area.

Mining

These 12 employees are engaged in sand and gravel operations that serve road and building construction needs in the Rim area.

Logging Camp and Contractors

These 184 employees are engaged in timber harvesting, slash disposal, erosion control, hauling, and constructing temporary roads associated with timber sales. Many, but not all, of these employees are located at Heber-Overgaard or Payson. They all derive their source of employment from within the study area. Their 9-10 month working season in the forest was converted to an annual figure.

Table 1. Allocation of employment created by sales of industrial groups - Mogollon Rim study area - Arizona

Industry from \ Sector to	Employment			Distribution of employment	
	Total	Export	Local	Export	Local
Agriculture	59	57	2	96%	4%
Mining	12	0	12	0	100
Logging camps and contractors	184	136	48	74	26
Sawmills	96	89	7	93	7
Construction	172	151	21	88	22
Lodging, eating and drinking places	129	94	35	73	27
Motor vehicle, retail and service	104	70	34	67	33
Other retail	154	97	57	63	37
Financial, insurance and real estate	93	73	20	79	21
Health services	74	33	41	44	56
Business and professional services	22	8	14	35	65
Personal and repair services	130	51	79	39	61
Utilities, communication, transportation and sanitation	73	28	45	38	62
Federal government	192	184	8	96	4
State government	42	28	14	67	33
Local government	92	0	92	0	100
	1,628	1,099	529	68%	32%

Source: 1970 U.S. Census, unpublished reports, plus primary data.

Sawmills

Approximately 26 percent of the timber harvested in the Rim area is processed at either Payson or Heber. Essentially all sales from this sector are to markets outside the area. Most of the lumber used for construction within the Mogollon Rim area is purchased from distributors in the Phoenix area.

Construction

At the present time, most construction activity in the Rim area is for retirement and summer homes. Thus, most employment in this sector is derived from money earned outside the Rim area and is appropriately placed in the export market.

Lodging, Eating, and Drinking Places

For about 7 to 9 months of the year, a sizeable portion of the business in this sector and the next two retail sectors comes from transient recreationists (especially true for businesses located on main highways) and summer home owners. For the remainder of the year, the highway business establishments still depend heavily on transient trade. All of these demand sources derive their income from outside the area, and 73 percent of the 129 employees in this sector were applied to the export market. Persons living on retirement in the community also contribute to these (export) sales.

Motor Vehicle - retail and service, and Other Retail

These two remaining retail sectors have employment separated between export and local markets for reasons similar to those mentioned above. The Motor Vehicle sector has a higher percentage of the local market because automobile repair is included. Other Retail is less dependent on export markets because it includes businesses such as dress shops, general stores, dry cleaners, etc. The majority still serve outside markets, however, and include bait shops, mobile home sales, gift shops, etc.

Financial, Insurance, and Real Estate

Of the three activities in this sector, the real estate portion is the most important from an employment viewpoint. Throughout the study area are real estate offices that do most of their business with customers from the Phoenix metropolitan area. There are over 100 subdivisions in the study area. While not all employ a full-time real estate agent, many persons in the Rim area sell real estate as a part-time venture.

Health Services

This sector, along with the next four, primarily serves local residents. Employment is concentrated at the Payson Hospital, a regional facility. According to hospital records, nearly half the hospital's patients are on Medicare, a fact that correlates well with census data regarding age distributions for the area. According to the 1970 U.S. Census, approximately 40 percent of the permanent households in the Rim Study Area derive their income from outside (non-local) sources, primarily retirement income such as social security, railroad retirement, and/or other pensions.

Business and Professional Services

This sector includes lawyers, engineer consultants, accountants, and clergy.

Personal and Repair Services

This sector includes all business and household services such as air conditioning, appliances, septic tanks, and similar services.

Utilities, Communication, Transportion & Sanitation

Utilities (electricity and gas) and transportation are the two most important areas of employment in this sector.

Federal Government

Essentially all of these employees work for the Forest Service, assigned either to the six Ranger Districts in the area or to the Job Corps Center at Heber. There is a small amount of employment with the Postal Service, which was treated as local because it primarily services local resident needs.

State Government

These 42 employees are in either public safety or highway departments, Camp Tonto-Zona, or the Game and Fish Department.

Local Government

The largest portion of employment here is for education, and includes teachers, school administration, and clerical help. There are also sheriff's office personnel, county highway departments, and justices.

As shown in Table 1, two thirds (68 percent) or the area's workforce (1,099 out of 1,628) may be assigned to export employment -- that is, they are engaged in producing goods and/or providing services for outside markets. This strong dependency on export employment combined with the closeness of the Phoenix metropolitan area (only a 1-1/2 hour drive from Payson) strongly mitigates any inducements to develop a locally strong supporting economy. Historically as well as currently, almost any major purchase -- construction materials, appliances, furniture, many services such as medical and dental -- is made in the Valley. With the current exponential population growth in the area (discussed in the final section of this chapter), there is rapidly developing an adequate population base capable of supporting a stronger local economy, one which is more dependent on local markets. To give some indication of the existing economic interdependence, a simple employment multiplier is developed below.

One question generally asked by a land manager is: What impact will a given change in policy have on local employment? For example, if the allowable timber cut is reduced or expanded, the direct effects are fairly easy to measure but the indirect effects are much more difficult to pinpoint. If use of the forest for recreation purposes changes, even the direct effects are difficult to measure because local spending patterns are generally unknown. A good example of Forest Service policy decisions which affect recreation use are forest closures during the fire season.

A general employment multiplier may be approximated by the expression (Tiebout 1962): 1/(1 - local employment/total employment), which is equivalent to the ratio of total to export employment. From the data in Table 1, the multiplier for the Mogollon Rim area is 1628/1099 = 1.48. The following paragraphs will consider what this number means, what it includes, and what its limitations are.

The multiplier includes not only the direct and indirect impacts resulting from an increase in employment in an export industry, but also the induced effects. The direct effect component of the multiplier is defined as 1.00, reflecting a one man-year addition (or reduction) in an export industry. Such an employment change would likely result from an increase in export demand, for example.

The indirect effect refers to the intermediate employment generated in the local industries as a result of the change in export employment. For example, if the local mill increased export sales sufficiently to justify hiring one additional employee, the effect this would have on employment in the logging camps, contractors, local retail establishments, or any other local industry, is defined as the indirect employment impact or effect. Because the study area exhibits little interdependency between local industries, the indirect multiplier is quite small.

The induced effect refers to the respending by households and local government, and is several times the indirect component. This accounts for the remaining portion of the total multiplier. As with the indirect effect, the induced effect refers to the spending -- in this case, by households and local government -- as a result of a change in export employment. An additional export employee, for example, spends part of his income for local taxes, on groceries from a local supermarket, on automobile service and gasoline, etc. This amounts to increased money for the government coffers, and more income for the retail and service establishments patronized by the new workforce member. But the chain of events does not stop here; the employees in each of the "patronized" industries (including government) spend part of their new-found income locally. The process repeats ad infinitum, but eventually reduces to insignificance.

The employment multiplier, then, relates the expected total change in non-export (local) employment as a result of a man-year change in an export industry. In general, therefore, an increase of one man-year in export employment will result in an additional one and one-half man-year (1.48) of employment through the regional economy. Likewise, an increase of 50 man-years spread throughout the five export industries would result in a total of 74 man-years employment for the economy (50 x 1.48 = 74).

Economists would describe Payson and the several smaller economic centers of the Rim Country as having high "import leakage", that is, only a small portion of the total locally sold goods is locally produced. Put another way, very little economic interdependence exists between local sectors. It is important to grasp the implications of an economy with high import leakages. Such an economy foregoes any significant impacts from secondary, and subsequent "rounds" (the indirect and induced effects) resulting from an initial employment change (the direct effect) because the rounds are sufficiently muted and rendered inconsequential. In such an economy, dollars travel, essentially, from the spending place directly to the households with no intermediate stops as in more (developed) interdependent economies. In an economy with very low interdependency, a change in demand (and hence, employment) for products of one sector will have little or no effect on demands (and hence, employment) faced by other sectors. With economic growth, interdependency increases; the effects of demand changes in one sector are increasingly felt by other sectors.

The significant leakages, apparent in this economy, are accounted for in the multiplier formula. A more self-sufficient economy would show higher secondary (indirect and induced) employment effects.

The multiplier derived above is similar to the one commonly derived using input-output (I-O) models (Miernyk 1966) when the households and local government sectors are made "endogenous" in the model, that is, they are included as intermediate production industries rather than as final demand sectors. The advantage of a fully developed I-O model is that the multipliers are sector specific, which is to say that for any sector of the I-O model, the secondary effects can be readily identified since each sector has its own multiplier. Since the Rim economy is so simple, however, this delineation is both unnecessary and statistically invalid. What small indirect effects exist are probably confined to the lumber-related industries. The induced effects should be similar for all five export sectors.

Before looking closer at the area's export industries, an important caveat is in order; technical conditions, assumed in employment multiplier as derived above, are incompletely fulfilled.1/ As a result, although the full multiplier impact does not occur overnight, multiplier values are valid only over the short run.2/ Because the economy is expanding rapidly in the Rim country, the multiplier should be recomputed yearly.

Over the longer run, there can be a local investment multiplier that is not incorporated into the employment multiplier. Because present investment in the study area primarily serves the export market, however, this effect is probably insignificant. As the local sectors develop and the economy becomes more interdependent, the investment effect will become more important.

Earlier in this section, five export industry groupings were identified: agriculture, lumber, transient recreation, persons on retirement living, and state and federal government. Because export sectors are the key to an area's economic development, some speculation about future changes in employment in these sectors will be instructive.

1/ For a more detailed discussion of the assumptions and limitations of the multiplier, see Nourse (1968, Chap. 7).

2/ Employment multipliers will change as economic structure (the division between export and local employment, for example) changes, which may or may not be significant in the Rim country where size is increasing geometrically, but where structural changes occur much more slowly. The effects (impact distribution) of the multipliers may also change over time.

Agriculture (essentially ranching) in the area has been declining in economic importance, and although nearly totally an export industry, the numbers of persons engaged in this work is small. The prospect is for a continued, but gradual, decline in ranching. From a developmental viewpoint, the agricultural sector is not the place to turn.

Lumber is a significant sector of the local economy. The supply of raw materials to the sector, however, is dependent on factors outside the industry's immediate control. There is little reason to expect any significant changes in National Forest allowable cut (based on the National Sustained Yield policy), or specifically, any notable change in timber sales within the Rim area. With increased environmental concern there is, in fact, every reason not to anticipate such changes. The prospect is for area mill employment and employment in supporting activities (such as cutting and hauling) to remain generally constant at current levels. Therefore, the lumber sector, though a significant component of the economy, will not likely play an important role in the area's future growth. In fact, it will play a progressively decreasing role as its share of the economic "pie" declines.

Transient recreation has increased dramatically over the past 10 years, and the increase has been particularly strong during the past 2-3 years. Employment attributed to transient recreationists is not directly available from Table 1 ; employment crosses several sectors, but is primarily limited to Lodging, Eating and Drinking Places, Motor Vehicle, Retail and Service, and Other Retail. A reasonable estimate is that 235 (total workforce = 1628) man-years are created as a direct result of transient recreation demand.

No doubt, persons choose to recreate in the Rim country for many reasons, but most would agree that the area's amenities along with the climatic relief afforded are the main drawing cards. We expect transient recreation demand to continue to increase for at least several years. However, transient recreation is not the sort of economic activity that develops strong economic interdependence; where they have been computed, indirect impact multipliers are low for transient recreation. Rim country services to transient recreationists will surely increase with the demand, but few interindustry linkages will develop. As noted earlier, persons who come to the Rim country for recreation often purchase supplies in Payson and in the other Rim communities. They may also purchase gas at local filling stations and eat at local restaurants. With the exception of the Kohl's Ranch complex, there is little in the way of resorts. In general, the transient recreationist behaves as though local community services are "convenience marts". The development of enterprises that would themselves be attractions might counter this economic behavior and increase economic interdependency.

Retirees living in the area represent an important export sector. Although their income source is external, much of their income is spent locally. Their initial impact is very significant because most retired people coming into the area build homes, creating a large portion of the export employment in the construction sector. Although it should be recognized that the life styles may differ somewhat, retiree economic behavior (income spending) should not differ too much from persons who earn their income locally. Like the other three basic sectors, Retirement has little indirect economic impact; the effect is, essentially, direct and induced.

On the average, one retired person living in the community easily outspends the typical transient recreationist. An extra retired person choosing to reside in the community will create much more export employment than an extra transient recreationist. Based upon available data, this sector is also the most rapidly expanding -- Agriculture is in a slow decline, Lumber is stationary, Transient Recreation is increasing, but not as rapidly as Retirement. Local businessmen should continually investigate the possibility of providing goods and services for local residents (retired or not) that currently are purchased in Phoenix.

The federal government, through the Forest Service, is a significant payroll source in the Rim study area. Forest Service employees account for essentially all non-state employment. Private employment resulting from management actions on the three National Forests throughout the area is also significant, especially in the Lumber sector. Important also are the many and varied impacts felt by the local communities as a result of Forest Service policies. Some of the more important impacts deserve mention.

With minor exceptions, all the timber cutting within the Rim study area occurs on federal lands. Table 2 shows estimated allowable cut for the study area by National Forest. As revealed by the data in Table 2, relatively little timber is available (under current policies is sustained yield) from the Tonto National Forest. Most available timber within the study area lies on the Sitgreaves National Forest. Although the Coconino is a significant timber-cutting National Forest, a relatively small portion of the volume cut on this Forest is within the study area.

The analysis of the forestry sector within the study area is complicated because of geographic overlap. Not all timber cut within the study area is processed within the study area, and some timber cut outside of the study area is processed within it. This is the result of basic transportation considerations, location and nature of the timber sales, mill capacities, current workloads, and other factors.

Table 2. Study area estimated allowable cut

National Forest	Estimated operable acres in study area	Annual allowable MMBF	M Cords
Tonto	48,000	3.6	4.6
Coconino	120,000	13.1	9.6
Sitgreaves	240,000	47.0	21.7
		63.7	35.9[1/]

1/ Existing and potential pulpwood volumes from this area have not been reliably inventories. Estimates by various qualified people differ from these figures by ± 50 percent.

Table 3 shows the estimated annual study area cut by mill. Only two of the mills (Heber and Payson) are within the study area. The Payson mill receives 60 percent of its raw wood from outside the area and the Winslow mill receives 83 percent of its raw wood from within the study area. The Heber mill depends on the study area for 80 percent of its raw wood.

During the wildfire season, the Regional Forester has the authority to restrict activities in and access to National Forests. Restrictions range from smoking and campfire prohibitions to full forest closure. Complete closure causes a severe negative economic jolt to the local communities, specifically the businesses within the communities that depend heavily on transient recreation trade. Less severe restrictions cause less severe impacts.

The annual Christmas tree harvest also influences the economy of the local communities. For a one dollar permit fee, persons may cut their own Christmas tree on National Forest land. Approximately 20,000 Christmas trees are cut yearly within the study area. Increased vehicular traffic at this time of the year is significant and one can only conclude that there is a sizeable local economic impact.

The availability of camp and picnic grounds and hiking trails also influences the numbers of persons coming to the area. This is the direct result of the Forest Service mandate to manage the National Forests for multiple use, which includes outdoor recreation. Persons are further attracted to the area for hunting, birding, or simply driving for pleasure on forest roads. Further investigations would be required to quantify the role of developed forest facilities in drawing persons to the area.

The discussion thus far has been restricted to the five export industries within the Rim study area. There are additional short-term projects that bring in outside money and create employment. These would include public works projects such as the Payson sewer system project, and large-scale private endeavors such as the large (345 KV) electrical transmission line constructed in the study area in 1963. Economic impacts resulting from these and similar projects can be strong but they are short-lived. Care must be taken not to misread the economic "signals" emanating from such projects.

Table 3.--Estimated annual cut by mill from study area

Location	Owner	Sawtimber (MMBF) Annual capacity	Sawtimber (MMBF) Study area cut	Percent capacity from study area
Payson	Kaibab Ind.	12.0[1/]	4.6	38
Flagstaff	Southwest For. Ind.	66.0[2/]	15.0	23
Winslow	Duke City Lbr Co.	30.0[2/]	25.0	83
Heber	Western Pine Sales	15.0[1/]	12.0	80
McNary	Southwest For. Ind.	60.0[1/]	9.0	15
			63.7	
		Pulpwood (M cords)		
Snowflake	Southwest For. Ind.	200[3/]	35	18

1/ Single daily shift of 8 hours

2/ Double shift

3/ Does not include material other than roundwood, such as sawmill residues, which make up the largest portion of of materials processed.

ECONOMIC CENTERS OF ACTIVITY

Payson Area

The Payson area is the second-fastest-growing area[1/] in the state. The population of Payson itself increased more than 400 percent from 1960 to 1970 (from 350 to 1,490). For the area within a 35-mile radius of Payson (which includes the Pine-Strawberry area), population jumped nearly 80 percent (from 1,789 to 3,208).

Tremendous growth has occurred during the past two years. The present population is probably between 2,500 and 3,000. Local businessmen foresee a population of 5000 within 5 to 7 years; analysis of the data leaves little room for debate.

Data relating to phone installation and electric utility customers help to dramatize the population increases. From 1964 to 1972, installation of business and residential phones increased rather steadily by 148 percent and 232 percent, respectively, and total customers for Arizona Public Service (APS) increased 128 percent during the same period (Table 4).

Payson, situated at the base of the Rim, is the gateway to the Mogollon Rim country. Persons driving from Phoenix to the Rim area will likely take the Beeline Highway (State Hwy 87) through Payson (Table 5). Although significant improvements have and still are being made on the Beeline Highway, the road was completed before the growth shown in the table. Likely important causal factors parallel those accounting for similar phenomena occurring elsewhere in the country, increased leisure time and increased real per-capita income being the two most significant.

The recent growth in the Payson area has significantly changed the local economic structure. The community is now considerably different from the Payson of 1960 (population 350), an economy tied to lumber, lumber-related activities, and ranching. Today, these industries are far less important, though they undoubtedly contribute to economic stability. Of dominant importance today, and showing strong signs of increasing importance for the future, are those economic activities related to serving the surging influx of people.

1/ Lake Havasu City (Mohave County) grew more than 700 percent from 1960 (pop. = 1364) to 1970 (pop. 11,520). Source: DEPAD.

Table 4--Phones installed and electrical hookups, Payson and vicinity.

	Phones installed Payson area*		Electrical utilities
	bus.	Res.	total customers±
1964	251	447	2,034
1965	274	551	2,340
1966	284	575	2,480
1967	352	633	2,621
1968	383	759	2,841
1969	424	835	3,136
1970	455	961	3,491
1971	566	1,172	3,993
1972	622	1,486	4,569

*Includes Payson, Pine, Strawberry, & Tonto. Data for Feb. of year indicated. Source: Mtn. States Telephone & Tele. Co.

± N. Gila County & Forest Lake Estates in Coconino County. Does not include Heber or Young. Source: Arizona Public Service.

Table 5.--Motor vehicle traffic in the Payson, Arizona area 1965-1971

Year	State Rt. 87 south of Payson	State Rt. 87 through Payson	State Rt. 87 Payson-Pine	State Rt. 160 east of Payson
1965	1,248	3,255	985	781
1966	1,135	3,249	666	1,004
1967	1,123	3,584	790	978
1968	1,337	3,759	848	1,113
1968	1,601	4,129	943	1,312
1970	1,759	4,448	1,066	1,674
1971	1,843	4,541	1,159	1,778

Source of data: Arizona Highway Department.

Establishments serving this influx depend largely upon a seasonal trade. Table 6 shows the monthly variation in traffic volume through Payson. Although these data are for 1971, data for other years and for other road sections tell the same story. Gasoline service stations on the Beeline Highway (main road through Payson) reported that about 70 percent of their annual business volume occurs between May 1 and November 1 (58 percent of the year). Discussions with businessmen and others leads to a conservative conclusion that the Payson area trebles its normal population during the summer months. As a result of this seasonal factor, businesses -- especially new ones -- that cater to transients are generally on the Beeline, while older, established firms (which cater more to locals) tend to be on Main Street, in the older portion of Payson.

Main Street businesses also feel a slack in trade during the winter months, though the drop is not as severe as for their competitors on the Beeline. December business on both the Beeline and Main Street is helped by a significant number of Valley residents coming to the Rim area to cut their own Christmas trees. In general, firms on the Beeline are transient-dependent, while those on Main Street depend primarily on local traffic and some transient customers.

Pine-Strawberry Area

The communities of Pine and Strawberry, 3 miles apart, are located approximately 15 miles northwest of Payson on the Beeline Hwy. Pine is the larger of the two, but they may be considered as one economic center of activity. Total 1970 population is estimated at 350. Historically dependent on ranching, the economy is rapidly becoming strongly dependent on transient recreation and second-home activities. The attractions and advantages here are similar to Payson, though the area is an additional 15 miles to the north (and 500 feet higher) and services are not nearly as well developed as in Payson.

Considerable private land is available in the immediate vicinity that could be developed for second homes and/or permanent residences. As urban and suburban growth in the Payson area tends to use up remaining local private land (notwithstanding newly created private lands resulting from the Forest Service's land exchange program), the Pine-Strawberry area is the economically rational place to pick up the demand. In fact, this is observable now; within five years the Pine-Strawberry area will likely be the hub of residential construction.

An important unknown is the Zane Grey Trail highway, now about 90 percent paved, that connects the Pine-Strawberry area to Camp Verde and the Black Canyon Highway to the west. Without special study it is difficult to estimate the impact this parkway-type highway will have, but it is safe to assume that it will significantly increase transient recreation.

Table 6.--1971 Monthly traffic volumes for Payson

Jan.	2,930	May	4,968	Sept.	5,446
Feb.	2,995	June	4,844	Oct.	5,279
March	3,716	July	6,304	Nov.	4,099
April	4,412	Aug.	5,875	Dec.	3,634

Young Area

Young is a ranching community approximately 17 miles south of State Hwy 260 (the connecting artery between Payson and Heber) on State Hwy 288. The estimated 1970 population is 150, including surrounding Pleasant Valley ranch households. Young is fairly isolated, a situation that will change if Hwy 288 is paved from Hwy 260 south to Young. With an ample private land base, the new paved highway, plus outstanding environmental amenities, the potential exists for Young to follow other northern Gila County communities in converting to a recreation-summer home type economy.

Even with the new paved highway, however, Young will remain relatively distant from origins of demand (Phoenix and Tucson areas). A 1-hour drive beyond Payson will be required from Phoenix, and travelers from Tucson will still have to negotiate 43 miles of dirt road (State Hwy 288). Further, Thompson and Lewis' census of potential and likely development sites in the Rim study area shows an abundance of such areas closer to Payson (1973), ignoring resale markets which will certainly increase. Because of its location, demand for second homes in the Young area should come nearly equally from Tucson and Phoenix. The Young area will likely see relatively modest development over the next 5 years, beyond which conditions could change considerably. Predictions into the late 70's and beyond are difficult.

Heber-Overgaard Area

The Heber-Overgaard area, like the Pine-Strawberry area, consists of two small communities in close proximity (3 miles) that, for purposes here, are considered one. Both are above the Rim at about 7000 feet elevation. The estimated population of Overgaard is 250, for Heber about 600 (including 200+ Corpsmen and 61 staff at the Heber Job Corps Center).

The area is important for timber-related activities: a sawmill in Heber employs about 60 individuals, and an independent logging contractor employs nearly the same number. The Forest Service maintains the Heber Ranger Station.

The area has long been popular for outdoor recreation. Second home development is occurring, but transportation-distance factors exercise a significant constraint in much the same way they do for the Young area. Like Young, the Heber-Overgaard area is in the trade-off zone between the two population centers of Phoenix and Tucson; demand for second homes and the like can be expected to be evenly mixed between Phoenix and Tucson households. The general quality of existing second homes in the area is low.

This is reflected in valuation and taxation records, but is most obvious to the eye, especially when compared with some of the well-planned developments to the east (White Mountains area). The general low quality of second homes may be a deterent to future high-quality dwellings, but may also be a precursor of things to come.

Average family size is above the national average: 5 for Heber and 4.8 for Overgaard. These large family sizes are likely due to the strong Mormon ties. Approximately 50 Indians live in the area and are employed in timber-related activities, either at the Heber mill or in the woods. Apparently, the only blacks in the area (approx. 150) are employed at the Job Corps Center.

The economy is historically timber-oriented, although ranching has a long history. Transient recreation is increasing, and recreational dwelling developments are making significant inroads. The Job Corps Center has a significant economic impact on the communities. A salary survey shows that local residents' earnings are comparable to those of wage earners in other parts of northern Arizona.

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"Communities should be planned with an eye to the effect made upon the human spirit by being continuously surrounded with a maximum of beauty."

Thomas Jefferson

VI. Rural Residential Development

CHAPTER VI

RURAL RESIDENTIAL DEVELOPMENT ON PRIVATE LAND IN THE MOGOLLON RIM AREA OF ARIZONA

by

James C. Thompson and Gordon D. Lewis[1/]

The Mogollon Rim is a unique geological feature extending across central Arizona for 200 miles in a roughly northwest to southeast direction. This large escarpment is the high point in the transitional zone that separates the Sonoran Desert from the Colorado plateau. The coniferous forest in the transitional zone of the Rim contains much of the ponderosa pine used by Arizona's forest industries, and is the source of much of the State's water. Yet, this same forest makes the Rim one of the finest outdoor recreation areas in Arizona. Phoenicians, who are only 2 hours driving time from the western end of the Rim, use the area extensively for recreation, climatic relief, and a distinct change in environment.

The Rim area provides Phoenicians with the most convenient opportunity for forest recreation in a State where such opportunities are in short supply. Since the Phoenix Metropolitan Area is one of the fastest growing urban centers in the nation, even greater numbers of people will be seeking forest recreation along the northwestern sector of the Mogollon Rim.

The vast majority of land along the Mogollon Rim is in public ownership, but there are numerous small private inholdings intermingled with the public lands. In the past these private holdings were used primarily for grazing or other agricultural uses. Grazing livestock under permit on public lands is possible year-around in this area, so large private holdings are unnecessary for ranching, and generally crop production has not proven economically feasible. As a result, there has been a major increase since the end of World War II in the conversion of these lands to residential use. The buffer of public land surrounding these private inholdings apparently assures a permanent "green belt" or a choice recreation area, and limits the overall extent of individual developments. These factors increase the attractiveness of ownership of lots in the rural subdivisions.

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The housing in these subdivisions has been predominately used as secondary residences. In recent years, a more permanent type of occupancy, particularly retirement living, has become increasingly evident, but buildings for recreational, leisure, or summer homes still appear to be the major motivation for ownership in the area. The distinction between uses is not exact, however, and the duration and frequency of occupancy is as varied as the reason for ownership. Escape from urbanization is the most obvious reason, and many of the homes erected are completely or partially owner-built. Relatively few of the homes are rented.

The proximity of these rural subdivisions to three National Forests (the Tonto, Coconino, and Sitgreaves) and the fact that purchases in them have been primarily for recreational usage, are creating demands on the National Forests. Residents use the Forests for outdoor activities, and there are a growing number of requests for special use permits for access roads, utility lines, and waste disposal areas. It can be expected that there will be additional demands on the forests in proportion to the increases in subdivision activity. This growth in demand will have a definite effect on the job of forest management.

In an effort to determine the extent of this development and to indicate the probable impacts on land management alternatives, the Rocky Mountain Forest and Range Experiment Station, in cooperation with Region 3, U.S. Forest Service, undertook a study on the rural residential development of the Mogollon Rim. The study area, located almost in the center of the State, covers approximately 1,000 square miles on the western end of the Rim. It is bounded by the Strawberry-Pine communities on the west, Payson and Young on the south, Heber on the east, andthe beginning of the pinyon-juniper grasslands on the north. This study was limited to subdivisions on private lands in northern Gila County, southwestern Navajo County, and southern Coconino County. Public lands with which the private lands were intermingled were on the Tonto, Sitgreaves, and Coconino National Forests. The assessment of rural residential development will serve as an input into a comprehensive land use plan being prepared for the same area.

To evaluate the extent and probable impact of the development of these rural subdivisions on public land management alternatives, scientists from the Rocky Mountain Forest and Range Experiment Station:

1. Determined the total area of private land in the study area and the area, by location, of private lands dedicated to subdivision.

2. Analyzed data from State and County tax records for subdivided lands to determine the number of lots established and sold, the origin of the buyers, the number of lots with permanent structures, and the tax valuation of the developments.

3. Held discussions with public land managers, county supervisors, state and county planning and tax officials and other community leaders to determine the social and economic impact of the existing subdivision.

4. Evaluated the outlook for future development of rural subdivisions and its potential impacts on National Forest lands.

5. Outlined possible procedures for handling these impacts to reduce adverse effects.

SUBDIVISION DEVELOPMENT

Within the study area, there were almost 66,000 acres of land in private ownership in 1972 (Table 1). That part of Coconino County in the study area accounted for almost half of the total. The 66,000 acres of deeded land represents the total amount of private land that could conceivably be dedicated to private residential or recreational development under the existing ownership pattern. Complete development, however, would be unlikely. Topography and accessibility would impose constraints, and certain parts of the areas would be taken up by business enterprises and service facilities.

In 1972, some 8,000 acres of the privately owned land had been recorded for tax purposes as being dedicated to subdivisions (Table 2). This constitutes about 12 percent of the total private land, and contains 150 subdivisions that have been established in the study area since 1945. A total of 16,555 lots, ranging in size from less than a quarter of an acre to over 4 acres, had been platted. Average lot size was just under one-half acre.

Table 1.--Private land in the Mogollon Rim area of Arizona by county and township, 1972.

Gila County		Coconino County		Navajo County	
Township and Range	Area	Township and Range	Area	Township and Range	Area
	Acres		Acres		Acres
12N - 8E	1,025	15N - 11E	1,364	13N - 15E	102
12N - 9E	1,358	15N - 12E	9,799	13N - 16E	758
12N - 10E	558	15N - 13E	4,375	12N - 16E	6,616
12N - 11E	160	14N - 10E	1,619	12N - 17E	5,808
11½N - 9E	56	14N - 11E	799	11N - 16E	154
11½N - 10E	239	14N - 12E	8,064	11N - 17E	115
11½N - 11E	228	14N - 13E	1,090		
11½N - 12E	142	14N - 14E	160		
11N - 8E	308	13N - 12E	1,626	Total	13,553
11N - 9E	251	13N - 13E	1,499		
11N - 10E	518	12N - 13E	59		
11N - 11E	343	12N - 13½E	68		
11N - 11½E	156	12N - 14E	54		
11N - 12E	417	11N - 13E	255		
10½N - 14E	226	11N - 14E	1,124		
10N - 10E	2,650	11N - 15E	280		
10N - 11E	170				
10N - 13E	854				
10N - 14E	234	Total	32,235		
10N - 15E	72				
9N - 13E	638				
9N - 14E	6,639				
9N - 15E	2,186				
8N - 13E	28				
8N - 14E	422				
8N - 15E	310				
Total	20,188				

TOTAL ALL COUNTIES 65,976 acres

Note: Areas of private lands in townships divided by county boundaries are included in the county having the greatest concentration of subdivisions.

Table 2.--Rural subdivisions in the Mogollon Rim area of Arizona by location, size, number, and sales transacted, 1972

Location by county and township and range[1/]	Total private land	Total land in subdivisions	Number of subdivisions	Total lots in subdivisions	Average size of lot	Proportion of lots sold
	Acres	Acres	Number	Number	Acres	Percent
Gila County						
12 N - 8 E	1,025	1,004	23	2,864	0.35	66
12 N - 9 E	1,358	227	3	440	.51	60
12 N - 10 E	558	102	2	196	.53	100
12 N - 11 E	160	32	1	63	.57	[2/] 114
11½ N - 10 E	239	231	3	832	.28	77
11½ N - 12 E	228	24	1	89	.27	[2/] 101
11 N - 10 E	518	647	15	2,439	.27	88
11 N - 11 E	343	50	3	161	.31	75
11 N - 12 E	417	100	5	452	.23	92
11 N - 13 E	255	18	2	145	.12	97
10½ N - 14 E	226	199	4	410	.48	92
10 N - 10 E	2,650	832	26	1,784	.47	94
10 N - 11 E	170	85	2	235	.36	8
10 N - 13 E	854	25	1	63	.39	100
9 N - 13 E	638	196	1	44	4.45	9
9 N - 14 E	6,639	136	3	97	1.40	44
All County	16,278	3,908	95	10,314	.38	79
Coconino County						
15 N - 11 E	1,364	611	5	538	1.14	90
14 N - 10 E	1,619	135	2	135	1.00	73
14 N - 12 E	995	390	2	475	.83	27
11 N - 14 E	1,124	819	10	826	.99	97
11 N - 15 E	280	80	2	85	.94	96
All County	5,382	2,035	21	2,059	.98	78
Navajo County						
12 N - 16 E	6,616	289	2	166	1.74	44
12 N - 17 E	5,808	1,943	32	4,016	.48	35
All County	12,424	2,232	34	4,182	.53	36
All Locations	34,084	8,175	150	16,555	.49	68

1/ Includes only those townships in which subdivision were located in 1972.

2/ Some of the original lots were divided into smaller lots by purchaser.

This relatively small average lot size indicates that buyers will accept suburban-type developments as opposed to truly rural conditions with large areas of land per dwelling unit. In fact, in some developments, individual owners were re-dividing their relatively large lots into smaller units for resale.

Of the 16,555 lots that had been platted in the rural subdivisions of the Rim area, 11,274, or 68 percent, had been sold in 1972 (Table 3). While purchasers of the lots listed primary residences from many states, there was a marked regional concentration. Those with primary residences in Arizona accounted for 90 percent of the sales (Figure 1). Seventy percent of the buyers were from the Phoenix metropolitan area, approximately 100 miles south. Even though Phoenix and Tucson are somewhat comparable in regard to size and distance from the Rim study area, Tucsonans apparently avail themselves of similar recreational opportunities elsewhere. They purchased only about 1 percent of the lots sold in the study area.

Of the 10 percent of lots purchased by people with primary residences outside of Arizona, Californians, primarily from Los Angeles, accounted for the greatest number.

The purchasers of 1,476 lots who listed permanent Rim area addresses may use their lots either for year-around dwellings or for speculation. However, it is probable that the ultimate usage of many of these lots will be for second homes.

There were also some indications that long-time residents of the study area, as well as new arrivals attracted by employment opportunities in the expanding business and service sectors of the local economy, are moving into more modern housing in the new subdivisions. If this continues, the Rim economy will become stronger and will attract more diverse types of development.

Dwelling units had been erected on 3,317 lots in 1972. Although frame structures accounted for 86 percent of the housing in the rural subdivisions (Table 4), it is quite probable that this ratio will change due to the increasing popularity of mobile home living. It is also probable that multiple dwelling units, presently rare in the area, will become a more important type of dwelling.

Only 20 percent of all the available lots and 29 percent of the purchased lots had housing units on them. Evidently these relatively low percentages are a result of several factors. Some of the subdivisions

Table 3.--Lots purchased in subdivisions in Mogollon Rim area of Arizona, by location of lot and primary residence of owners, 1972.

(Number of lots)

Location by county and township and range[1/]	Total lots	Primary residence of purchaser					
		Phoenix	Rim area	Tucson	Other Arizona	California	Other United States
Gila County							
12N - 8E	1,868	1,388	212	14	83	93	78
12N - 9E	266	196	32	0	6	17	15
12N - 10E	196	162	14	4	1	5	10
12N - 11E	72	59	7	0	1	3	2
11½N- 10E	641	513	20	2	32	51	23
11½N- 12E	90	81	1	0	3	3	2
11N - 10E	2,162	1,509	297	23	95	90	148
11N - 11E	121	60	44	1	6	2	8
11N - 12E	416	338	29	9	11	13	16
11N - 13E	142	113	22	0	1	5	1
10½N- 14E	374	312	10	2	19	10	21
10N - 10E	1,690	768	617	3	85	73	144
10N - 11E	19	15	4	0	0	0	0
10N - 13E	63	51	6	0	1	2	3
9N - 13E	4	4	0	0	0	0	0
9N - 14E	43	22	1	0	4	0	16
All County	8,167	5,591	1,316	58	348	367	487
Coconino County							
15N - 11E	487	233	0	0	211	20	23
14N - 10E	99	77	0	0	14	5	3
14N - 12E	124	117	1	0	4	2	0
11N - 14E	805	668	12	12	60	22	31
11N - 15E	82	60	2	4	5	6	5
All County	1,597	1,155	15	16	294	55	62
Navajo County							
12N - 16E	73	51	11	1	3	5	2
12N - 17E	1,437	1,047	134	26	87	44	99
All County	1,510	1,098	145	27	90	49	101
All Locations	11,274	7,844	1,476	101	732	471	650

1/ Includes only those townships in which subdivisions were located in 1972.

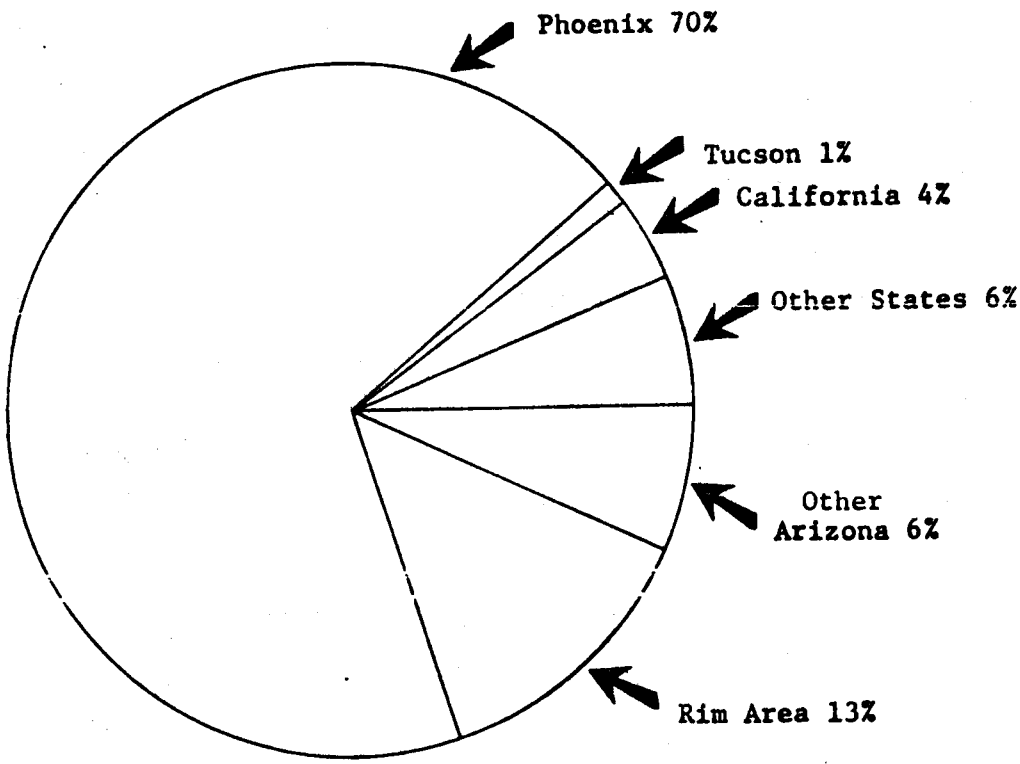


Figure 1-- Primary residence of lot owners in the Mogollon Rim Study Area, 1972.

Table 4.--Rural subdivision valuation in the Mogollon Rim area of Arizona by location and component, 1972

Location by county and township and range 1/	Lots		Frame houses		Mobile homes		Total tax valuation		
	Total	Average tax valuation	Total	Average tax valuation	Total	Average tax valuation for improvements 2/	Land	Houses and improvements	All
	Number	Dollars	Number	Dollars	Number	Dollars	$1,000	$1,000	$1,000
Gila County									
12 N - 8 E	2,864	1,966	566	5,254	56	1,091	5,632	3,035	8,667
12 N - 9 E	440	2,576	122	4,743	8	731	1,134	585	1,719
12 N - 10 E	196	3,598	78	6,338	2	6,313	705	507	1,212
12 N - 11 E	63	5,252	20	4,906	0	0	331	98	429
11½ N - 10 E	832	2,408	140	6,037	4	672	2,003	848	2,851
11½ N - 12 E	89	1,617	51	4,103	0	0	144	209	353
11 N - 10 E	2,439	1,819	383	5,923	115	2,237	4,436	2,526	6,962
11 N - 11 E	161	1,863	31	6,085	1	222	300	189	489
11 N - 12 E	452	2,424	165	5,243	12	822	1,096	875	1,971
11 N - 13 E	145	3,821	66	5,867	6	301	554	389	943
10½ N - 14 E	410	1,830	105	4,603	8	217	750	485	1,235
10 N - 10 E	1,784	2,244	451	9,379	84	1,298	4,003	4,339	8,342
10 N - 11 E	235	1,465	1	58,523	3	648	344	60	404
10 N - 13 E	63	1,032	2	7,421	0	0	65	15	80
9 N - 13 E	44	2,959	4	2,190	0	0	130	9	139
9 N - 14 E	97	988	0	0	0	0	96	0	96
All County	10,314	2,106	2,185	6,272	299	1,552	21,723	14,169	35,892
Coconino County									
15 N - 11 E	538	1,264	108	4,115	0	0	680	444	1,124
14 N - 10 E	135	1,000	39	2,883	0	0	135	113	248
14 N - 12 E	475	1,053	0	0	0	0	500	0	500
11 N - 14 E	826	2,000	195	3,405	0	0	1,652	664	2,316
11 N - 15 E	85	2,000	33	3,481	0	0	170	115	285
All County	2,059	1,524	375	3,563	0	0	3,137	1,336	4,473
Navajo County									
12 N - 16 E	166	1,155	12	9,012	0	0	192	108	300
12 N - 17 E	4,016	1,042	330	5,829	116	1,834	4,186	2,136	6,322
All County	4,182	1,047	342	5,941	116	1,834	4,378	2,244	6,622
All locations	16,555	1,766	2,902	5,882	415	1,631	29,238	17,748	46,986

1/ Includes only those townships in which subdivisions were located in 1972.

2/ Tax valuation for improvements only. Mobile homes are taxed by the state as vehicles.

Note: Average tax valuation columns rounded to nearest dollar.

are of such recent origin that lot owners have not had time to erect housing, and some of the lot owners do not immediately intend to erect housing; rather these lots have been purchased for personal campgrounds or parking areas for campers and trailers. Others have purchased lots for speculative or investment reasons, and do not intend to invest in structures.

Whatever the reasons for lot ownership in the subdivisions, sale of lots and land improvements have increased the tax base of the counties involved. In 1972, tax valuations of the lots in rural subdivisions amounted to $21.7 million in Gila County, $3.1 million in Coconino County, and $4.4 million in Navajo County, for a total of $29.2 million in the study area. When the valuation for housing and other improvements was added, the total valuation for the subdivision development was $35.9 million, $4.5 million and $6.6 million, respectively, in each of the counties, and $47 million for the Rim area.2/

County officials have indicated, however, that the revenues from this tax base may not be sufficient to cover the increased costs to the counties for the services required by the residents of the new rural subidvisions. Nevertheless, it would appear that rural subdivisions must be a part of any future development programs. Many reports have emphasized that the development of major areas of the Rim for summer and retirement communities and commercial centers for tourist and recreation activities creates pressing needs, especially for adequate sewage and waste disposal facilities.3/ The "General Development Plan for Gila County" states that "Gila County's greatest potential for growth and development lies in this economic sector of tourism and recreation."4/

Figure 2 illustrates the relative amounts of subdivision development, by location, that had occurred in the study area by 1972. Most of the development was concentrated around the unincorporated towns of Payson, Pine-Strawberry, and Heber. The proportion of lots available, sold and having structures in the major areas are:

2/ Property taxes on lots having mobile homes were levied only for the land and such improvements as sheds, wells, sewage systems, etc. The mobile home was taxed separately as a vehicle by the State in 1972.

3/ Examples of these reports are "Environmental Needs Studies for Coconino and Gila Counties," "General Development Plan for Gila County," the "Planning Program and the County Water and Sewer Plan for Navajo County," and the "Payson Area Report of the Arizona Rural Development Committee."

4/ Ferguson, Morris and Associates. 1971. General Development Plan for Gila County Arizona. HUD Project No. ARIZ P-46. Phoenix, Arizona. p. 45.

Mogollon Rim Area

Fig.2 Concentration of Subdivisions

(33) Percent of Total Private Land In Subdivisions

Percent of Lots with Structures

Percent of Lots Sold

1 Square Inch = 1000 Lots

1 0 1 2 3 4

Scale in Miles

U. S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE
COCONINO, SITGREAVES, AND TONTO NATIONAL FORESTS
1972

KEY MAP

Area	Lots in subdivision	Lots sold	Lots with houses
	Percent		
Payson	26	34	31
Pine-Strawberry	20	19	22
Heber	25	13	14
All other	29	34	33
All areas	100	100	100

There is little commercial development, as yet, in the three areas along the Rim proper, the one area along the northern edge of the study area, and the small area at Young to the south.

Most of the development in the study area is south of the Rim on the Tonto National Forest and in Gila County. Most private lands in the large area north of the Rim on the Coconino National Forest and in Coconino County have not been dedicated to subdivision use. Accessibility of this region may have been an important reason for the absence of development. A lack of goodroads also probably accounted for the small amount of development in the Young area to the south. This situation could change quickly if access were improved and the area were promoted for residential development. The setting and the availability of private land would make the Young area favorable for establishing rural subdivisions. Possibly, too, the Pine-Strawberry area will begin to overtake the Payson area, or merge with it, as the Camp Verde access is improved and becomes known to Phoenicians. The Heber area, which has the greatest number of platted, but unsold, lots is the most distant concentration of subdivisions from Phoenix.

Despite the wide differences in the number of lots platted in the eight areas of subdivision concentration (Figure 2), the proportion of lots sold, but upon which housing has not been constructed, is almost the same, about two-thirds, in all the areas. The amount of housing in rural subdivision would double if structures are erected on lots now sold to individuals, but presently without structures, and increase five times if buildings are constructed on all lots that have been platted, but do not now have buildings on them.

Current subdivisions are not the limit of potential growth. The percentage in the box in each circle of concentration (Figure 2) indicates the proportion of private land dedicated to subdivisions in each area. In only two of the areas does this proportion exceed 50 percent. Thus, the potential for the establishment of new subdivisions is quite high.

In addition to the subdivision housing on private land, there were 265 summer or second homes on leased public land in the Tonto National Forest in Gila County which should be considered in the total housing impact upon the study area (Table 5). The Forest Service no longer issues new permits for this type of use, so the number of permittees should remain relatively constant. Potential impacts upon the area are limited by the terms agreed upon when the use permit was issued. Phoenix is the primary residence of 95 percent of these permit holders. The location of these summer home areas on the Tonto National Forest are shown in Figure 2.

CONCLUSIONS

Tax records indicate that there has been considerable rural subdivision development in the study area since 1946. Thus far, subdivision development has taken up only a small fraction of the private land in the study area (Figure 3).

The growth potential for development in the study area is evident. This growth will occur more rapidly than in previous years due to such causal factors and trends as increased real disposable income and leisure time, and improved transportation.

There appears to be no definite physical constraint to future subdivision development in the study area, and the apparent acceptance of relatively small lot sizes would seem to indicate that density of lots will not curtail growth. However, some concern has been expressed, notably by State and County officials, that developers and owners should be made to plan developments better to mitigate the undesirable impacts that indiscrete subdivision development engenders. These officials indicate that, in the future, the Counties and the State will require developers and owners to play a more responsible role, especially in regard to environmental needs and governmental services. This will be reflected in higher subdivision prices and taxes sufficient to carry the higher costs of services in remote areas.

Table 5.--Summer homes built under special use permit on National Forests in the Mogollon Rim area of Arizona

Location	Total	Primary residence of permittee				
		Phoenix	Rim area	Other Arizona	California	Other United States
Diamond Point	47	45	1	1	0	0
Ellison Creek	60	57	0	0	0	3
See Canyon	55	53	0	1	1	0
Thompson Draw	85	78	0	4	1	2
Washington Park	13	13	0	0	0	0
Isolated Units	5	5	0	0	0	0
Total	265	251	1	6	2	5

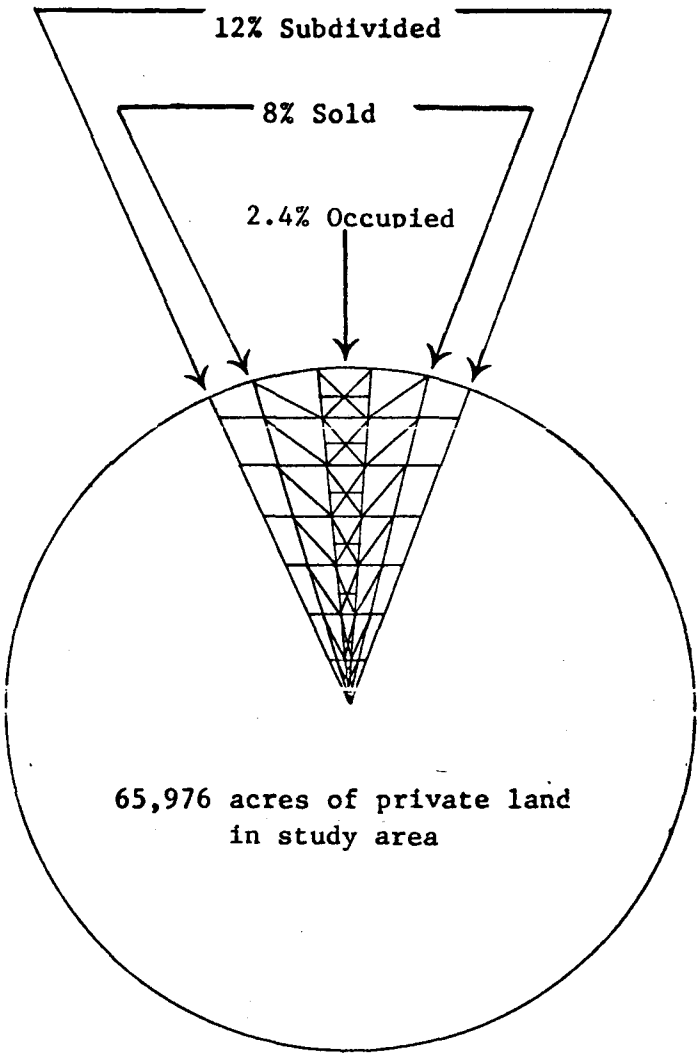


Figure 3--Relationships between the amount of available land of inholdings and the amount of land dedicated to subdivisions, sold, and occupied by dwelling units in the Mogollon Rim Study Area, 1972.

The continued growth of rural subdivisions in the Mogollon Rim study area will create some problems in management of the public land of the area. Based on past development activities, these problems have been identified as:

1. Trespass. There have been instances in which: a) lot boundaries and buildings have crossed National Forest boundaries and owners have used public land as their own, and b) some residents have been using the public land illegally in other ways, as for example, cutting trees for timber and firewood and grazing for recreational animals.

2. Waste Disposal. Too little consideration has been given to waste disposal by most of the subdivisions. Residents are routinely depositing garbage in containers in picnic areas, making unauthorized dumps on public land, or simply scattering their waste indiscriminately along roadways. Because most of the subdivisions have inadequate sewage facilities which do not meet health requirements, they may be polluting the water of the area.

3. Facility Use and Wildlife Depletion. Public recreation areas in the study area are extensively used by residents to the exclusion of transient recreationists. Fish and wildlife populations, which are already under pressure, are further depleted by the increases in hunters and fishermen. The development of subdivisions reduces habitat and restricts movement of wildlife.

4. Fire Danger. The potential for wildfire is greatly increased due to the increased number of people in the area for much longer periods of time. Residents, however, are more apt to report fires and aid in suppression due to their greater investment in the area. On the other hand, losses from fire spreading from the National Forests into subdivisions would involve more property damage, and liabilities from such an occurrence are unclear at the present.

5. Insects and Disease. There is some recent evidence to indicate that the potential for insect and disease outbreaks is increased by the disturbances following residential development in the forests, and that it is difficult to control insect buildups near buildings.

6. Special Use Permits. Rural subdivision development greatly increases the number of requests for all types of special use permits, but particularly for the construction of access roads and power lines and for waste disposal areas. Often these are key factors in development, and determine if the development can be economically successful.

In addition to these specific problem areas, the continued growth of rural subdivisions can be expected to create other areas of concern for public land managers. At some undetermined density, the subdivision development will begin to directly or indirectly interfere with the various product and service outputs from the National Forests. The residential growth will progressively create obstructions to, for example, the volume of timber harvested, the kind of recreation opportunity provided, or the quality and quantity of water produced.

Although the specific problem areas and other conflicts will increase as their impacts accumulate with further residential development, it is not felt that they will create a need for fundamental changes in National Forest management objectives in the study area in the near future. The impacts of further development, however, will necessitate accompanying changes in management practices to maintain the productivity of the resource base and the quality of the forest environment. More intensive management of the area will require additional administrative time and management expenses to develop closer working relationships with local government officials and land developers. For example, fuel breaks may have to be established around the subdivisions, and more public recreation opportunities made available for transients. By working closely with the State and Counties, the Forest Service can help in establishing standards that will insure that needed roads and waste disposal facilities are adequate for health and safety and for the perpetuation of the flow of products from the forests.

Consideration of rural residential development will have to become an accepted part of the forest management program, and the increased administrative and managerial effort and expense must be included as a part of the operation. This will require surveillance of residential growth, more communication with the publics involved, and the employment of innovative techniques and individuals to solve and prevent negative impacts. To ignore development is to ignore a powerful force that could severely alter future management directions.

The growth of rural subdivisions in the study area will continue, in the main, to be a consequence of influences originating from the Phoenix metropolitan area. Population growth in the Phoenix area will serve as an indicator of the types and extent of future impacts upon the forests of the Rim. Forest Service perspective for the Rim country will increasingly need to take into account the urbanization in the Valley and the relationship between the Valley and the Rim.

"Living things, as a whole, emerged from the non-living skin of the earth. Life is a very powerful form of chemistry, which, once on the earth, rapidly changed its surface. Life begets life, so that once new forms appeared in a favorable environment, they could proliferate and spread until they occupied every suitable environmental niche within physical reach."

Barry Commoner, 1971

VII. *Land Response Units*

VII. LAND RESPONSE UNITS

A. Formation of LRU's

A Land Response Unit is a unit of land relatively uniform throughout its extent in landform, soil, vegetation, and climate. It can be regarded as having similar possibilities and problems for land use and will respond similarly to management. It has a distinctive type of environment and provides a similar range of habitats for man, plants and animals. Thus, a Land Response Unit is a homogeneous unit of the landscape that has strong uniformity in: slope, elevation, aspect, climate, geomorphic feature, soil characteristics, type and density of vegetation, type and rate of erosion, and surface runoff characteristics.

The basic input for constructing the LRU is obtained from a Soil Resource Inventory. Soils are classified according to accepted national standards. The classification reflects the climate and capability of the soils.

Since soils occur on landscapes, slope and geomorphic features (landform) play an integral part in developing Soil Resource Inventory Mapping Units. The landscape and soil information is used to determine erosion hazard, slope classes, runoff hazard, and the features of importance.

Rating LRU's - Ratings for response units are based on land sensitivity and soil capability.

Land Sensitivity - A number of factors influence the stress capability (sensitivity) of the land. Slope, erosion hazard and runoff potential are among the most important. Other factors to consider are those that provide low bearing strength when wet, poorly drained soils and areas of high water table.

These erosion hazard classes representing low, medium and high sensitivity ratings were developed based on potential soil loss under specified conditions. Three slope sensitivity ratings were defined as follows:

Low - 0-15 percent

Medium - 16-30 percent

High - 31 plus percent

Three runoff potential classes were defined with ratings of low, medium and high. These ratings are based on amounts of runoff from specified storms on bare soil conditions.

To arrive at sensitivity ratings of high, medium and low, the sum of the weighted values was obtained for each of the classes for erosion hazard, slope and runoff potential. The ratings are as follows:

Low - 0-1.5

Medium - 16-30 percent

High - 31 plus percent

Soil Capability - General soil capability is dependent on moisture, temperature, and nutrient supply and is governed by the limiting factor. Soil moisture regimes are defined in terms of the amount of moisture available for plant growth. Precipitation patterns, temperature, aspect and soil texture play a major role in determining soil moisture regimes.

Soil temperature is another factor governing plant growth. Soil temperature regimes are defined on the basis of specified mean annual soil temperature ranges. Both the moisture regimes and soil temperature regimes generally are equated with vegetative associations and elevation zones.

Soil nutrient regimes are defined in terms of high, medium and low. The ability of a soil to supply nutrients is largely dependent on effective depth, texture, pH, ion exchange complex, organic matter content, parent rock, and degree of profile development.

Soil capability ratings are the result of combining moisture, temperature, and nutrient supply factors. Soil capability ratings are designated as low, medium and high.

There are nine possible combinations of high, medium and low capability and sensitivity with different combinations of moisture, temperature, and nutrient regimes on different kinds of landforms. These combinations result in specific vegetative associations with well defined erosion and hydrologic processes and relatively uniform engineering characteristics. The result is a unit of land with similar capabilities for production of biomass and similar stress capacity to withstand activities operative upon it.

Twenty-two Land Response Units have been recognized in the study area.

B. LRU Descriptions

Descriptions of the Land Response Units are presented in the Table at the end of this Chapter. Most of the columns are self-explanatory, but some need further clarification of information or symbols.

The column headed "Climate" contains terms for soil moisture and temperature regimes. Two soil temperature regimes occur in the study area. These are frigid and mesic. Mean annual soil temperatures for frigid regimes are 32°F to 47°F, with mean summer temperatures greater than 47°F. The lowest mean annual soil temperatures in this area are not less than 40°F.

Terms for moisture regimes within the area are Udic and Ustic. Udic (wet) sites are those where soil moisture is not limited for plant use. Ustic (moist) sites are those where moisture is limited, but is partly available for use when conditions are favorable for plant growth.

The Vegetative Association and Species column contain symbols for the dominant association in each Response Unit. The symbols and associations are as follows:

PP - Ponderosa pine

MC - Mixed conifer

MM - Mountain meadow

PJ - Pinyon-juniper

PP-Emory Oak - Ponderosa pine-Emory oak

PP-Shrub - Ponderosa pine-shrub

C. Soil Use Potentials

Timber Production Potential - Interpretative ratings are based on phases of soil series and are obtained by height over age measurements on dominant trees only. A minimum of four trees per stand are sampled on known soil phases.

Site index ratings are obtained from standard Region 3 site index curves to obtain productivity classes for all species adapted to a site. The classes are as follows:

Site Index (Ft.)	Productivity Class	Production Potential
75 plus	I	High
55-74	II	Medium
54 and less	III	Low

Herbage Production Potential - Interpretative ratings are based on phases of soil series and are obtained by clipping data and ocular estimates. Clipped plots are 0.96 square feet in size. Properties of the soil that influence the available moisture and nutrient regime are the dominant factors that influence grass production capabilities. These factors are: depth, texture, structure, organic matter content, coarse fragments and soil reaction (acidity).

Accepted classes used by soil scientists in Region 3 are:

Lbs. of Air Dried Herbage Per Acre	Productivity Class	Production Potential
1,000 - 2,000 plus	I	High
500 - 1,000	II	Medium
0 - 500	III	Low

Wildlife Feed Potential - Criteria for rating soils for potential to produce feed for wildlife have not been standardized. However, the ability of a soil to produce an abundance of diverse, palatable species can be rated with uniformity by soil scientists.

Since wildlife utilize grasses, forbs, grass-like plants, shrubs and some trees (browse), the potential to produce each of these must be considered. Different kinds of soil possess different capabilities dependent upon various combinations of soil properties.

1. The criteria for grass, grass-like, and forb potential are different from "browse" potential, and are the same as for grass production potential described above.

2. Browse potential (includes shrubs and trees normally used as a source of feed, such as aspen and Gambel oak).

   High - Soils that are capable of supporting vigorous growth of aspen (Class I or II) or those capable of sustained production of diverse species of shrubs palatable to wildlife.

Potential shrub canopy cover is greater than 25 percent and not inaccessible due to very steep or stony, bouldery or rocky surfaces.

Medium - Soils capable of supporting Class III aspen or those capable of supporting a shrub canopy density of 10 to 25 percent of diverse and palatable species. Soils are neutral to mildly alkaline, shallow or moderately deep, medium to moderately fine textured, stony and cobbly but with less than 50 percent coarse fragments in the control section.

Low - Soils incapable of sustained aspen growth or those that support less than 10 percent shrub canopy cover. Soils are more acid than neutral, fine or coarse textured, and coarse fragment content of the surface or control section is greater than 50 percent.

Recreation Site Development Potential - Interpretation of soils to determine suitability for recreation developments are based on soil physical properties and terrain. The ratings reflect the human carrying capacity of the land while maintaining a quality environment. The ratings are intended primarily for camp and picnic ground sites and associated components such as unsurfaced roads, trafficability (foot traffic), septic tank filter fields, vault toilets and site productivity.

The ratings are as follows:

High

Slopes 0 to 5 percent
Loam and sandy loam textures
Deep and very deep soils to bedrock
Coarse fragments - gravel - 0 to 15 percent
stone and cobble - 0 to 5 percent
boulders and rock outcrop - none
Infiltration - moderate to very rapid
(.63 to greater than 20 inches/hour)
Permeability - moderately rapid to very rapid
(2.0 to greater than 20 inches/hour)
Drainage - well drained
Flood hazard - none
Site productivity - high

Medium

Slopes 6 to 15 percent
Loamy sand, fine sandy loam, very fine sandy loam, silt loam, clay loam, and sandy clay loam textures
Moderately deep and some deep soils to bedrock (20 to 48 inches)
Coarse fragments - gravel - 16 to 50 percent
cobble and stone - 6 to 25 percent
boulders - less than 15 percent
Infiltration - moderately slow to slow (.06 to .63 inches/hour)
Permeability - moderate to moderately slow (.20 to 2.0 inches/hour)
Drainage - moderately well to excessive
Flood hazard - none
Site productivity - medium

Low

Slopes greater than 16 percent
Sandy clay, silty clay, clay, texture or loose sand
Shallow soils to bedrock
Coarse fragments - gravel - greater than 50 percent
cobble and stone - greater than 25 percent
boulders - greater than 15 percent
Infiltration - very slow (less than .06 inches/hour)
Permeability - slow to very slow (less than .63 inches/hour)
Drainage - poorly or somewhat poorly drained
Flood hazard - floods during season of use
Site productivity - low

Water Storage - Water storage capacity is the amount of water that can be held in a soil and is affected primarily by depth, texture, coarse fragments and bulk density. The ratings are as follows:

FC (Field Capacity)

High - greater than 18 inches

Medium - 12 to 18 inches

Low - less than 12 inches

AWHC (Available Water Holding Capacity)

High - greater than 9 inches

Medium - 6 to 9 inches

Low - less than 6 inches

Runoff Potential - Potential for surface runoff is the potential to generate runoff as overland flow during storms or as retention potential that might be released to stream channels as base flow.

(1) Overland flow is largely a function of internal soil properties that influence infiltration, percolation and hydrologic soil groups. Slope, vegetation and climate, although not related to hydrologic groups, are external factors that influence runoff.

The ratings are as follows:

High - All hydrologic group D, regardless of slope. Hydrologic group C_1 on slopes steeper than 30 percent. Runoff curve number is greater than 70.

Medium - Hydrologic group C_1 on less than 30 percent slopes. Hydrologic group C_2. Hydrologic group B_1 on slopes steeper than 15 percent. Hydrologic group B_2 on slopes steeper than 30 percent. Runoff curve numbers range from 41 to 70.

Low - Hydrologic group B_1 on less than 15 percent slopes. Hydrologic group B_2 on less than 30 percent slopes. Hydrologic group A. Runoff curve numbers are less than 40.

(2) Retention potential available for base flow (inter-flow) considers hydrologic group, slopes and climate, hydraulic conductivity, effective depth for water storage, substratum characteristics, and drainage basin morphology.

High - Very deep, moderate and moderately rapid permeable soils on slopes in excess of 15 percent. (Includes most hydrologic group B and C_2 soils with greater than 60-inch effective depths.) These soils could provide greater than 5 acre-inches of water.

Moderate - Deep and moderately deep soils (greater than 30-inch effective depth) with moderately slow to moderately rapid infiltration and permeability rates. (Most hydrologic group B_2 and C_2 soils with other conditions as specified.) These soils could provide one to five acre-inches in excess of evapo-transpiration.

Low - Shallow and moderately deep soils with less than 30-inches effective depth regardless of infiltration or permeability rates. All soils rated hydrologic group D.

Less than one acre-inch of water available for streamflow.

Natural Beauty - While it might be easy to provoke an argument over whether one unit is more beautiful than another, it is plain than the natural beauty characteristics of each unit are different, and can be described. The rating listed is a composite score for the unit, based on consideration of variations in landform (topographic relief), vegetation, color, the presence of water, and the effects of man. The criteria used are defined in the Appendix, along with a table which summarizes the scores of each LRU.

Representative Wildlife - Species listed are the ones which seem to use each LRU for significant periods of time.

LAND RESOURCE RESPONSE UNIT DESCRIPTIONS

LAND RESPONSE UNIT	RATING	LANDFORM	CLIMATE	VEGETATION ASSOC. & IMPORTANT SPECIES	GEOLOGY	SOIL UNIT	SOIL NAME	SLOPE %	ELEVATION	SOIL CHARACTERISTICS	EROSION HAZARD	USE POTENTIALS: TIMBER	HERBAGE	BROWSE	RECREATION SITE DEVELOPMENT	WATER STORAGE: FC	WATER STORAGE: AWHC	RUNOFF POTENTIAL: OVERLAND	RUNOFF POTENTIAL: BASEFLOW	REPRESENTATIVE WILDLIFE	NATURAL BEAUTY
1	$C_H S_L$	PLATEAU (RIDGES)	FRIGID-UDIC PRECIP. IS 20 TO 28 INCHES. MEAN ANNUAL SOIL TEMP. IS 40 to 45°F.	PP AND MC PONDEROSA PINE DOUGLAS-FIR WHITE FIR ARIZONA FESCUE MOUNTAIN MUHLY KENTUCKY BLUE GRASS WESTERN YARROW	KAIBAB LIMESTONE COCONINO SANDSTONE	173 174 274 278	McVICKERS fsl McVICKERS vfsl McVICKERS gfsl SOLDIER kl SOLDIER-McVICKERS ASSN.	0-20 5 AVE.	6,800 - 8,000 7,500 AVE.	THICK, MODERATELY COARSE TO MEDIUM TEXTURED, GRAVELLY AND COBBLY LIGHT COLORED SURFACE LAYERS UNDERLAIN BY STONY, REDDISH CLAY. DEEP AND VERY DEEP TO ROCK. MODERATELY WELL TO WELL DRAINED. STRONGLY ACID TO NEUTRAL.	LOW	HIGH HIGH REGEN. POTENTIAL	HIGH HIGH REVEG. POTENTIAL	LOW	HIGH	HIGH	HIGH	LOW	HIGH	ELK, MULE DEER, TURKEY, ABERT SQUIRREL, RED SQUIRREL, GOSHAWK, SONGBIRDS, RAPTORS	MEDIUM
2	$C_H S_M$	PLATEAU (SLOPES)	FRIGID-UDIC 20-28 INCH PRECIP MEAN ANNUAL SOIL TEMP. IS 40 TO 45°F.	PP AND MC, SOME MM, SOME MAPLE-ALDER INCLUDED PONDEROSA PINE DOUGLAS-FIR WHITE FIR ARIZONA FESCUE NEW MEXICO LOCUST KENTUCKY BLUE-GRASS ASPEN	KAIBAB LIMESTONE COCONINO SANDSTONE	175 262 270	McVICKERS SOLDIER McVICKERS V. ROCKY COMPLEX SOLDIER kl INCLUDES SOME CLOVER SPGS. AND LUTH	20-60 40 AVE.	7,000 8,000 7,500 AVE.	SAME AS ABOVE, BUT IN ADDITION THERE IS 10 TO 40 PERCENT ROCK OUTCROP.	MODERATE - HIGH	HIGH HIGH REGEN. POTENTIAL	HIGH HIGH REVEG. POTENTIAL	LOW	LOW	HIGH	HIGH	LOW-MEDIUM	HIGH	ELK, MULE DEER, TURKEY, RED SQUIRREL, SONGBIRDS, ABERT SQUIRRELS, BAND-TAILED PIGEON	MEDIUM
3	$C_L S_H$	SCARP AND CANYON LANDS	FRIGID-MESIC UDIC-USTIC 16-28 INCH PRECIP MEAN ANNUAL SOIL TEMP. IS 40 TO 55°F.	MC-PP-PJ PP-EMORY OAK WHITE FIR DOUGLAS-FIR PONDEROSA PINE ASPEN GAMBEL OAK EMORY OAK ARIZONA WHITE OAK ONE-SEED JUNIPER PINYON PINE MOUNTAIN MAHOGANY NEW MEXICO LOCUST	KAIBAB LIMESTONE COCONINO SANDSTONE SUPAI SANDSTONE	102	LIMESTONE AND SANDSTONE ROCKLAND	40-120 70 AVE.	6,200 7,800	SHALLOW AND MODERATELY DEEP UNDIFFERENTIATED SOILS AND 40 TO 100 PERCENT ROCK OUTCROP.	HIGH	NOT SUITED TO LOW	LOW LOW REVEG. POTENTIAL	LOW	LOW	LOW	LOW	HIGH	LOW	WHITETAIL DEER, MOUNTAIN LION, BEAR, RAPTORS, SONGBIRDS, ELK FISHERIES, WATER FOWL, ABERT SQUIRRELS BAND-TAILED PIGEON	HIGH
4	$C_L S_M$	PLATEAU	FRIGID-UDIC 17-28 INCH PRECIP MEAN ANNUAL SOIL TEMP. IS 40 TO 47°F, MOST IS LESS THAN 45°F.	PP AND MC SOME MAPLE-ALDER PONDEROSA PINE DOUGLAS-FIR GAMBEL OAK ROCKY MTN. MAPLE THIN LEAF ALDER SCOULER WILLOW SNOWBERRY KENTUCKY BLUE-GRASS SEDGE	COCONINO SANDSTONE TERTIARY ALLUVIUM	160 161 190 191 fsl 183 184 188 52	PALOMINO vstfsl PALOMINO V. ROCKY 1 SANCHEZ vst AND ex.st. WILDCAT vst & st fsl WILDCAT gfsl TELEPHONE McVICKERS DURAN gcl	0-40 15 AVE.	6,800-7,800 7,400 AVE.	SHALLOW, MODERATELY DEEP AND DEEP STONY AND VERY STONY, THIN FINE SANDY LOAM TO LOAM AND CLAY LOAM SURFACE LAYERS UNDERLAIN BY STONY CLAY AND CLAY LOAM SUBSOILS. SOMEWHAT POORLY TO WELL DRAINED. MEDIUM ACID TO NEUTRAL. INCLUDES SOME MODERATELY WELL AND SOMEWHAT POORLY DRAINED FRIANA SOILS.	MEDIUM AND LOW	LOW - MEDIUM MEDIUM TO LOW REGEN. POTENTIAL	LOW - MEDIUM LOW TO MEDIUM REVEG. POTENTIAL	MEDIUM	LOW - MEDIUM	LOW-MED	LOW MED.	MEDIUM-LOW	LOW	ELK, RAPTORS, SONGBIRDS, WHITETAIL BAND-TAILED PIGEON, TURKEY, WATER FOWL, MULE DEER, ABERT SQUIRREL, BLACK BEAR, MTN. LION	LOW
5	$C_M S_L$	PLATEAU (BROAD) RIDGES	FRIGID-UDIC 17-22 INCH PRECIP MEAN ANNUAL SOIL TEMP. IS 46 TO 48°F.	PP PONDEROSA PINE GAMBEL OAK ALLIGATOR JUNIPER ARIZONA FESCUE MTN. MUHLY PINE DROPSEED PRAIRIE JUNE GRASS MUTTON GRASS	KAIBAB LIMESTONE COCONINO SANDSTONE TERTIARY ALLUVIAL	178 256 284 177 62 50 174	JACKS-McVICKERS HOGG sl HOGG fsl McVICKERS HOGG SIXTY-TWO sl SHOWLOW gl McVICKERS fsl	0-10 5 AVE.	6,700-7,400 7,000 AVE.	THIN TO MODERATELY THICK SURFACE LAYERS UNDERLAIN BY REDDISH CLAY SUBSOILS, MODERATELY DEEP AND DEEP, WELL DRAINED. SLIGHTLY ACID TO MILDLY ALKALINE.	LOW	MEDIUM MEDIUM REGEN. POTENTIAL	MEDIUM-HIGH	MEDIUM HIGH	MEDIUM	HIGH	MED.	MEDIUM	MEDIUM	MULE DEER, ELK, TURKEY, ABERT SQUIRREL, SONGBIRDS	LOW
6	$C_M S_M$	PLATEAU AND MESA	FRIGID-UDIC 20-24 INCH PRECIP MEAN ANNUAL SOIL TEMP. IS 44 TO 46°F.	PP (OPEN) PONDEROSA PINE GAMBEL OAK PINE DROPSEED MOUNTAIN MUHLY	BASALT AND CINDERS	562 592	BROLLIAR vstcl SIESTA kl	0-20 5 AVE.	6,800-7,700 7,200 AVE.	MODERATELY DEEP AND DEEP, WELL DRAINED WITH STONY AND VERY STONY LOAM AND CLAY LOAM SURFACE LAYERS AND CLAY SUBSOILS. LOW BEARING STRENGTH WHEN WET. MILDLY ALKALINE TO NEUTRAL.	MEDIUM	MEDIUM-LOW LOW - MED. REGEN. POTENTIAL	MEDIUM MED. - HIGH REVEG. POTENTIAL	MEDIUM	MEDIUM	MED.	MED.	MEDIUM	MEDIUM	MULE DEER, ELK, TURKEY, ABERT & RED SQUIRREL, SONGBIRDS, BAND-TAILED PIGEON	MEDIUM
7	$C_M S_H$	SCARP VOLCANIC CONE	FRIGID-UDIC 20-25 INCH PRECIP MEAN ANNUAL SOIL TEMP. IS 44 TO 46°F.	PP PONDEROSA PINE GAMBEL OAK NEW MEXICO LOCUST DOUGLAS-FIR MOUNTAIN MUHLY PINE DROPSEED	BASALT, CINDERS SANDSTONE AND SHALE (MOENKOPI)	562AB 210 592A	BROLLIAR vstcl CHILSON kcl SIESTA kl	10-45 20 AVE.	7,200 8,074	SHALLOW, MODERATELY DEEP, WELL DRAINED WITH STONY AND VERY STONY LOAM AND CLAY LOAM SURFACE LAYERS UNDERLAIN BY CLAY SUBSOILS. NEUTRAL TO MILDLY ALKALINE.	MEDIUM-HIGH	MEDIUM-LOW MED-LOW REGEN. POTENTIAL	MEDIUM MEDIUM REVEG. POTENTIAL	MEDIUM	LOW	MED. LOW	MED. LOW	HIGH	LOW-MEDIUM	WHITETAIL DEER, BAND-TAILED PIGEON, BEAR, MTN. LION, ABERT SQUIRREL, SONGBIRDS, MULE DEER, RAPTORS, RED SQUIRRELS	MEDIUM

LAND RESOURCE RESPONSE UNIT DESCRIPTIONS

LAND RESPONSE UNIT	RATING	LANDFORM	CLIMATE	VEGETATION ASSOC. & IMPORTANT SPECIES	GEOLOGY	SOIL UNIT	SOIL NAME	SLOPE %	ELEVATION	SOIL CHARACTERISTICS	EROSION HAZARD	USE POTENTIALS: TIMBER	HERBAGE	BROWSE	RECREATION SITE DEVELOPMENT	WATER STORAGE: FC	WATER STORAGE: AWHC	RUNOFF POTENTIAL: OVERLAND	RUNOFF POTENTIAL: BASEFLOW	REPRESENTATIVE WILDLIFE	NATURAL BEAUTY
8	$C_H S_H$	PLATEAU	MESIC-USTIC UDIC, 15-18 INCH. PRECIP. MEAN ANNUAL SOIL TEMP. IS 48 TO 55°F	PP (OPEN) TO PJ PONDEROSA PINE GAMBEL OAK ALLIGATOR JUNIPER CLIFFROSE PRAIRIE JUNE-GRASS ARIZONA THREE-AWN GERANIUM BUCKWHEAT	COCONINO SANDSTONE KAIB/B LIMESTONE	192 171 172 190 171 172	JACKS fsl JACKS - TORTUGAS ex. rocky complex SANCHEZ vstfsl JACKS-SANCHEZ ELLEDGE (UDIC)	0-45 15 AVE.	6,300-6,900	MODERATELY DEEP AND DEEP, WELL DRAINED SOILS WITH THIN SURFACE LAYERS UNDERLAIN BY REDDISH, CLAYEY SUBSOILS DERIVED FROM SANDSTONE. SHALLOW, STONY, WELL DRAINED SOILS WITH LIGHT COLORED SURFACE LAYERS UNDERLAIN WITH THIN SUBSOILS OVER SANDSTONE AND SHALLOW, WEAKLY DEVELOPED, STONY SOILS FROM LIMESTONE. MILDLY TO MODERATELY ALKALINE. SOME ARE CALCAREOUS.	MEDIUM	LOW - NOT SUITED LOW - MED REGEN. POTENTIAL	MEDIUM-LOW MED - LOW REVEG. POTENTIAL	MEDIUM-HIGH	LOW - MEDIUM	LOW-MED.	LOW-MED.	MEDIUM	LOW	MULE DEER, ELK, TURKEY, ANTELOPE, SONGBIRDS, RAPTORS, PREDATORS, COTTONTAIL RABBIT	MEDIUM
9	$C_L S_H$	PLATEAU	MESIC-USTIC 12-16 INCH PRECIP MEAN ANNUAL SOIL TEMP. IS 48 TO 56°F	PJ AND SHORT GRASS GRASSLAND PINYON PINE ONE-SEED JUNIPER CLIFFROSE SKUNK BUSH ALGERITA WINTER FAT BLUE GRAMA WESTERN WHEAT	KAIBAB LIMESTONE COCONINO SANDSTONE	194 195 250 251 vst1 261 261D 252 254 260	DYE fsl DYE vstfsl PURNER gl TORTUGAS vst1 TORTUGAS rocky loam PURNER-DYE TORTUGAS gl WINONA gl	0-40 15 AVE.	6,200-6,800	SHALLOW, GRAVELLY, STONY AND ROCKY, WELL TO EXCESSIVELY DRAINED SOILS WITH WEAK DEVELOPMENT. PREDOMINANTLY LOAMY TEXTURES AND SOME CLAY SUBSOILS LIGHT AND DARK COLORED FROM LIMESTONE AND SANDSTONE. MILDLY TO MODERATELY ALKALINE. SOME ARE CALCAREOUS.	LOW-MEDIUM	NOT SUITED	MEDIUM-LOW MED-LOW REVEG. POTENTIAL	HIGH-MEDIUM	LOW	LOW	LOW	MEDIUM	LOW	MULE DEER, TURKEY ELK, SONGBIRDS, PREDATORS, ANTELOPE, COTTONTAIL RABBIT, RAPTORS	LOW
10	$C_H S_H$	PLATEAU (SLOPES)	FRIGID-UDIC 17-22 INCH PRECIP MEAN ANNUAL SOIL TEMP. IS 46 TO 47°F	PP PONDEROSA PINE GAMBEL OAK ARIZONA FESCUE FENDLER CEANOTHUS MOUNTAIN MUHLY SQUIRRELTAIL	KAIBAB LIMESTONE COCONINO SANDSTONE	177A 175 235 178	McVICKERS HOGR McVICKERS vstfsl HOGR-McVICKERS JACKS-McVICKERS	10-35 20 AVE.	6,800-7,500	SEE UNITS 1 and 5.	MEDIUM	MEDIUM MED-HIGH REGEN. POTENTIAL	MEDIUM MED-LOW REVEG. POTENTIAL	MEDIUM	LOW-MEDIUM	HIGH	MED-HIGH	LOW-MEDIUM	MEDIUM	MULE DEER, TURKEY, WHITETAIL DEER, ELK, SONGBIRDS, ABERT SQUIRRELS, FISHERIES	MEDIUM
11	$C_H S_H$	ALLUVIAL BOTTOMS	FRIGID-UDIC 18-20 INCH PRECIP MEAN ANNUAL SOIL TEMP. IS 40 TO 48°F	MM (ASPEN ON FRINGE AREAS) TIMOTHY KENTUCKY BLUEGRASS RED TOP TUFTED HAIRGRASS SEDGES, RUSHES, CLOVER, ASPEN	RECENT ALLUVIUM	1 647 2(7) 5	LUTH cl CLOVER SPGS sil, 1 FRIANA loam ZENIFF fsl	0-5	6,800-7,600	DEEP, SOMEWHAT POORLY TO WELL DRAINED, MEDIUM TO FINE TEXTURED DARK COLORED, WEAKLY DEVELOPED SOILS. MILDLY ACID TO MODERATELY ALKALINE.	HIGH	NOT SUITED	HIGH HIGH REVEG. POTENTIAL	LOW	LOW-MEDIUM	HIGH	HIGH	LOW (SUBJECT TO FLOODING & ACCUM. FROM SURROUNDING AREA)	HIGH	ELK, TURKEY, SONGBIRDS, RAPTORS, MULE DEER	MEDIUM
12	$C_H S_H$	ALLUVIAL PLAINS	FRIGID-UDIC 25-30 INCH PRECIP MEAN ANNUAL SOIL TEMP. IS 44 TO 48°F	PP PONDEROSA PINE GAMBEL OAK ARIZONA FESCUE SQUIRRELTAIL PINE DROPSEED	OLD ALLUVIUM	60 61 80 81	OVERGAARD vgfsl OVERGAARD vgfsl COLCORD vksil COLCORD vksil	0-40 15 AVE.	6,500-7,700	DEEP, WELL DRAINED, GRAVELLY AND COBBLY SOILS WITH MODERATELY THICK, COARSE TEXTURED SURFACE LAYERS UNDERLAIN BY REDDISH	MEDIUM	MEDIUM HIGH-MED REGEN. POTENTIAL	MEDIUM MEDIUM REVEG. POTENTIAL	LOW	MEDIUM-LOW	HIGH	HIGH	LOW	HIGH	WHITETAIL DEER, MULE DEER, BEAR TURKEY, ABERT SQUIRREL, BAND-TAILED PIGEON , ELK	MEDIUM
13	$C_H S_H$	ALLUVIAL PLAINS AND TERRACES	MESIC-UDIC 25-30 INCH PRECIP MEAN ANNUAL SOIL TEMP. IS 40 TO 56°F.	PP AND SOME GRASSLAND OAK-SYCAMORE IN RIPARIAN AREAS PONDEROSA PINE ARIZONA SYCAMORE ALLIGATOR JUNIPER ARIZONA WHITE OAK	RECENT ALLUVIUM	4 45 10 65	CORDES fsl EXT. ST. ALLUVIAL LAND HEBER PYEATT LOAM	0-10 3 AVE.	4,600-6,500	DEEP, MODERATELY COARSE TO MODERATELY FINE TEXTURED, WEAKLY DEVELOPED, WELL TO IMPERFECTLY DRAINED SOIL FROM MIXED ALLUVIUM. INCLUDES SOME STRATIFIED, EXTREMELY STONY SOILS ON PRESENT FLOOD PLAINS. SLIGHTLY ACID TO MILDLY ALKALINE.	HIGH, GULLY	HIGH-LOW AND SOME NOT SUITED HIGH-LOW REGEN. POTENTIAL	HIGH-LOW MEDIUM REVEG. POTENTIAL	HIGH-LOW	LOW TO NOT SUITED FLOOD HAZARD	HIGH-LOW	HIGH-LOW	LOW	HIGH	SONGBIRDS, TURKEY, FISHERIES, GRAY SQUIRREL, WHITETAIL DEER, MULE DEER, ABERT SQUIRREL, RAPTORS	MEDIUM
14	$C_H S_H$	ALLUVIAL PLAINS AND TERRACES	MESIC-USTIC 20-25 INCH PRECIP MEAN ANNUAL SOIL TEMP. IS 50 TO 56°F	SHORTGRASS GRASSLANDS PJ AND PP ONE-SEED JUNIPER PINYON BLUE GRAMA	OLD ALLUVIUM	697 70	SHOWLOW ext. kcl	0-45 20 AVE.	5,000-6,000	DEEP, WELL DRAINED, WELL DEVELOPED WITH THIN SURFACE LAYERS UNDERLAIN BY GRAVELLY AND COBBLY CLAY SUBSOIL. CALCAREOUS AT LOWER DEPTHS. MILDLY ALKALINE.	LOW-MEDIUM HIGH GULLY	LOW-MEDIUM LOW REGEN. POTENTIAL	HIGH HIGH-MED. REVEG. POTENTIAL	MEDIUM	MEDIUM NOT SUITED	HIGH	HIGH	MEDIUM	LOW	MULE DEER, COTTONTAIL, SONGBIRDS, PREDATORS, JAVELINA	MEDIUM
15	$C_H S_H$	BENCHLANDS	MESIC-UDIC 25-30 INCH PRECIP MEAN ANNUAL SOIL TEMP. IS 48 TO 52°F	PP-BUNCHGRASS SOME OAK - SYCAMORE IN RIPARIAN AREAS PONDEROSA PINE ALLIGATOR JUNIPER GAMBEL OAK MANZANITA	CARBONIFEROUS SHALE SANDSTONE LIMESTONE QUARTZITE	751 274-2	AMOS scl CHERRY CREEK sicl	0-15 8 AVE.	5,500-6,300	MODERATELY DEEP AND DEEP, WELL DEVELOPED, WELL DRAINED SOILS WITH FINE TEXTURED SUBSOILS. SLIGHTLY ACID TO MILDLY ALKALINE.	MEDIUM HIGH GULLY	HIGH HIGH REGEN. POTENTIAL	HIGH HIGH REVEG. POTENTIAL	MEDIUM	MEDIUM	HIGH	HIGH-MED.	MEDIUM	LOW	ELK, SONGBIRDS, TURKEY, MULE DEER, GRAY SQUIRREL	MEDIUM

LAND RESOURCE RESPONSE UNIT DESCRIPTIONS

LAND RESPONSE UNIT	RATING	LANDFORM	CLIMATE	VEGETATION ASSOC. & IMPORTANT SPECIES	GEOLOGY	SOIL UNIT	SOIL NAME	SLOPE %	ELEVATION	SOIL CHARACTERISTICS	EROSION HAZARD	USE POTENTIALS: TIMBER	HERBAGE	BROWSE	RECREATION SITE DEVELOPMENT	WATER STORAGE: PC	WATER STORAGE: [illegible]	RUNOFF POTENTIAL: OVERLAND	RUNOFF POTENTIAL: BASEFLOW	REPRESENTATIVE WILDLIFE	NATURAL BEAUTY
16	$C_H S_H$	LOW HILLS	MESIC-UDIC 25-30 INCH PRECIP MEAN ANNUAL SOIL TEMP. IS 48 TO 52°F	PP - BUNCHGRASS SAME AS 15 ALSO SOME ARIZONA CYPRESS	CARBONIFEROUS SHALE SANDSTONE LIMESTONE QUARTZITE	753 274	AMOS stcl CHERRY CREEK stcl	25-60	5,500-6,500	SAME AS UNIT 15	HIGH	HIGH MED-HIGH REGEN. POTENTIAL	MEDIUM-HIGH MED-HIGH REVEG. POTENTIAL	MEDIUM	LOW-NOT SUITED	HIGH-MED	HIGH-MED	MEDIUM-HIGH	LOW	ELK, TURKEY, MULE DEER, ABERT SQUIRREL, BAND-TAILED PIGEON, SONGBIRDS	MEDIUM
17	$C_M S_L$	BENCHLANDS	MESIC-UDIC 25-30 INCH PRECIP MEAN ANNUAL SOIL TEMP. IS 48 TO 52°F	PP-SHRUB SOME OAK-SYCAMORE IN RIPARIAN AREAS PONDEROSA PINE ALLIGATOR JUNIPER MANZANITA CEANOTHUS SQUIRRELTAIL	SANDSTONE SHALE LIMESTONE	680 690 760	VERDE ext. st. sl ZANE st fsl DIAMOND RIM vstl	0-20 10 AVE.	5,500 6,700	MODERATELY DEEP AND DEEP, MODERATELY WELL TO WELL DEVELOPED, WELL DRAINED WITH CLAY SUBSOIL. SOME SHALLOW, FINE TEXTURED SOILS.	LOW	MEDIUM MED-HIGH REGEN. POTENTIAL	MEDIUM-HIGH HIGH REVEG. POTENTIAL	MEDIUM	MEDIUM-LOW	MED	MED	LOW	MEDIUM	MULE DEER, ELK, SONGBIRDS, TURKEY, ABERT SQUIRREL, RAPTORS, COTTONTAIL RABBITS, GRAY SQUIRRELS	MEDIUM
18	$C_M S_M$	LOW HILLS	MESIC-UDIC 25-30 INCH PRECIP MEAN ANNUAL SOIL TEMP. IS 48 TO 52°F	PP - SHRUB SOME OAK - SYCAMORE IN RIPARIAN AREAS SAME AS 17	SANDSTONE SHALE LIMESTONE	682 762	VERDE ext. st. sl DIAMOND RIM ROCKLAND	10-50 25 AVE.	5,500-6,700	SAME AS UNIT 17, BUT MORE ROCKLAND.	MEDIUM-HIGH	MEDIUM MED-HIGH REGEN. POTENTIAL	MEDIUM LOW REVEG. POTENTIAL	MEDIUM	NOT SUITED LOW	MED	MED	MEDIUM	MEDIUM	MULE DEER, ELK, SONGBIRDS, TURKEY ABERT SQUIRREL, RAPTORS, WHITETAIL DEER	MEDIUM
19	$C_M S_L$	LOW HILLS AND BASINS	MESIC-USTIC TO UDIC, 20-26 INCH PRECIP. MEAN ANNUAL SOIL TEMP. IS 40 TO 55°F	PJ - SHRUB SOME AREAS OF PP UTAH JUNIPER PINYON ARIZONA OAK EMORY OAK MANZARITA WRIGHT SILK-TASSEL DESERT CEANOTHUS FENDLER CEANOTHUS SHRUB LIVE OAK BIRCH LEAF MTN. MAHOGONEY YUCCA, AGAVE, SIDE OATS GRAMA HAIRY GRAMA	GRANITE DIORITE DIABASE	456 353 481	LITTLE RANCH - BARKERVILLE JAYARR sl ROCKINSTRAW gscl	0-20 8 AVE.	4,900-5,400	MODERATELY COARSE AND COARSE TEXTURED, WEAKLY TO MODERATELY WELL DEVELOPED. WELL DRAINED SOILS WITH DARK COLORED SURFACE LAYERS OVER DEEPLY WEATHERED GRANITE, DIORITE AND DIABASE. NEUTRAL TO SLIGHTLY ACID.	LOW-MEDIUM	NOT SUITED LOW POCKETS OF CLASS II LOW-MED REGEN. POTENTIAL	MEDIUM MED-LOW REVEG. POTENTIAL	MEDIUM-HIGH	MEDIUM-LOW	LOW-MED	LOW-MED	LOW	MEDIUM	MULE DEER, BAND-TAILED PIGEON, ABERT SQUIRREL, SONGBIRDS, COTTONTAIL RABBITS	MEDIUM
20	$C_L S_H$	LOW HILLS AND BASINS	MESIC-USTIC TO UDIC, 20-26 INCH PRECIP. MEAN ANNUAL SOIL TEMP. IS 48 TO 55°F	PJ - SHRUB SOME AREAS OF PP SAME AS 19	GRANITE DIORITE DIABASE	457 354 453-D 482 453-B 370 372	LITTLE RANCH BARKERVILLE JAYARR ext. st sl BARKERVILLE vgsl ROCKINGSTRAW gscl BARKERVILLE vgsl QUEARE gscl QUEARE ext. st. scl	0-70 40-50 AVE.	4,900-5,600	SAME AS UNIT 19. ALSO INCLUDES SOME DEEP, WELL DEVELOPED SOILS WITH CLAY SUBSOIL.	HIGH	NOT SUITED LOW	MEDIUM-LOW LOW REVEG. POTENTIAL INCLUDES SMALL AREAS WITH HIGH REVEG. POTENTIAL	MEDIUM-HIGH	LOW	LOW	LOW	LOW MEDIUM	MEDIUM	MULE DEER, BAND-TAILED PIGEON, SONGBIRDS, COTTONTAIL RABBITS	MEDIUM
21	$C_H S_L$	MESA	MESIC-USTIC 20-25 INCH PRECIP MEAN ANNUAL SOIL TEMP. IS 50 TO 58°F	SHORTGRASS GRASSLAND PJ - SHRUB SAME AS 19 ALSO BLUE GRAMA, GALLETA	BASALT FLOWS AND OLD ALLUVIUM FROM BASALT AND SAND-	156 271	THUNDERBIRD gk and ext.st cl JACKS st cl, 0-15	0-15	4,800-5,400	MODERATELY DEEP WELL DRAINED SOILS WITH THIN CLAY LOAM SURFACE LAYERS UNDERLAIN BY CLAY RESTING ON BASALT, LS, SS, AND SHALE. THUNDERBIRD SOILS ARE CALCAREOUS AT LOWER DEPTHS. MILDLY TO MODERATELY ALKALINE.	LOW-MEDIUM	NOT SUITED	HIGH HIGH REVEG. POTENTIAL	LOW	LOW-MEDIUM	HIGH	MED	HIGH	MEDIUM	MULE DEER, COTTONTAIL RABBITS	LOW
22	$C_M S_M$	LOW HILLS AND BASINS	MESIC-USTIC 20-25 INCH PRECIP MEAN ANNUAL SOIL TEMP. IS 50 TO 56°F	PJ - SHRUB SHORTGRASS GRASSLAND SOME DESERT GRASSLAND SAME AS 21 ALSO ARIZONA CYPRESS	BASALT LIMESTONE SHALE SANDSTONE	157 764 765	THUNDERBIRD CABEZON ROUNDTOP vstl ROUNDTOP ROCKLAND COMPLEX	0-50 25-30 AVE.	4,600-5,500	SHALLOW AND MODERATELY DEEP, WELL DRAINED SOILS WITH STONY, GRAVELLY, COBBLY AND CLAY LOAM SURFACE LAYERS UNDERLAIN BY CLAY SUBSOILS RESTING ON BASALT LIMESTONE, SHALE AND SANDSTONE. MILDLY TO MODERATELY ALKALINE.	MEDIUM-HIGH	NOT SUITED	MEDIUM LOW-MED REVEG. POTENTIAL	MEDIUM	LOW	LOW-MED	LOW	HIGH	LOW	MULE DEER, SONGBIRDS, FISHERIES, COTTONTAIL RABBITS, PREDATORS	MEDIUM

TABLE VII-2

MOGOLLON RIM AREA
ACREAGES BY RESPONSE UNIT
AND ADMINISTRATIVE AREA

COUNTY	Coconino				Navajo	Gila		
FOREST	Coconino		Sitgreaves			Tonto		
DISTRICT	Long Valley	Blue Ridge	Chevelon	Heber		Payson	Pleasant Valley	TOTAL
1	4,287	17,874	38,074	18,984	20,178	--	--	99,398
2	12,926	18,770	1,808	683	4,565	--	--	55,351
3	--	27,089	25,361	1,365	256	52,130	22,503	128,705
4	3,349	7,700	26,876	19,048	1,962	--	--	58,935
5	1,386	5,780	6,612	192	6,735	--	--	20,306
6	6,783	6,762	--	--	--	--	--	13,544
7	4,031	3,626	--	--	--	--	--	7,658
8	--	6,356	28,262	5,162	14,568	--	--	54,349
9	--	2,069	35,258	6,292	11,774	--	1,685	57,079
10	427	11,710	6,122	18,258	17,810	--	--	54,328
11	384	981	619	192	3,903	--	--	6,079
12	--	--	--	2,090	14,718	1,898	10,729	29,435
13	--	--	--	--	1,578	5,268	1,493	8,340
14	--	--	--	--	--	--	20,327	20,328
15	--	--	--	--	--	7,402	512	7,913
16	--	--	--	--	--	21,394	8,084	29,478
17	--	--	--	--	--	13,353	192	13,545
18	--	--	--	--	--	30,736	11,966	42,703
19	--	--	--	--	--	8,127	--	8,127
20	--	--	--	--	--	13,950	1,792	15,742
21	--	--	--	--	--	5,439	--	5,439
22	--	--	--	--	--	16,040	--	16,040
TOTAL	33,573	108,718	185,592	72,266	97,648	175,738	79,284	752,821

TABLE VII-3

SUMMARY OF

VISUAL QUALITY (NATURAL BEAUTY) RATINGS*

LRU	LANDFORM	VEGETATION	COLOR	WATER	EFFECTS OF MAN	OVERALL COMPOSITE
1	4	3	2	4	8	Medium
2	6	5	5	5	8	Medium
3	9	8	6	8	9	Medium
4	4	3	2	4	4	Low
5	5	2	3	4	3	Low
6	5	5	5	4	5	Medium
7	5	3	3	4	4	Medium
8	3	3	4	2	6	Medium
9	3	3	2	2	6	Lwow
10	5	3	3	4	8	Medium
11	3	5	5	3	5	Medium
12	8	5	6	2	3	Medium
13	6	4	6	2	6	Medium
14	5	8	5	7	8	Medium
15	2	4	3	3	6	Medium
16	5	4	4	4	8	Medium
17	2	4	3	4	7	Medium
18	5	5	3	4	7	Medium
19	3	5	4	5	5	Medium
20	6	4	4	3	5	Medium
21	2	4	2	2	5	Low
22	5	5	3	4	4	Medium

*Criteria used are summarized in Appendix D. Scale used: 1 (poor) to 9 (good).

"There would be an environment fit for a man, and a man fit for the environment; the creative process requires that the environment be made more fit, that the man adapt the environment and himself.... This involves identifying those environments fit for an organism or process, identifying the organism...fit for the environment and inaugurating the process whereby the organism and the environment is adapted to accomplish a better fitting."

Ian L. McHarg, 1969

VIII. *Suitable Land Uses*

VIII. SUITABLE LAND USES

The lands of the Rim Area are characterized by extreme variations in soil, slope, climate, natural drainage, vegetation and other factors. These lands have definite limits of use, beyond which productivity declines, erosion sets in, and other qualities tend to deteriorate. These limits are physical and biological, and were discussed in the preceding Chapter through an objective examination of the land characteristics. This physical capability of the land to withstand use is but one part of land use planning. Of equal importance is an examination of the suitability of land for use from the standpoint of each use's effect on the living qualities of the environment, and its potential contributions to the values desired from the Rim Area. The study team has attempted to make such an examination, without drawing conclusions concerning uses except in terms of the two questions (1) Can it be done without adverse effects? and (2) Can it contribute values of benefit to people? This chapter is an attempt to describe this analysis.

A. Uses Considered

An area as well endowed with the variety of landforms, vegetation and climate as the Mogollon Rim area, is adapted to the production of a wide variety of benefits of value. Such wide-ranging uses as hay-cutting, seismological research, apiary sites, gravel and sand production, and commercial timber production have occurred within this area. In addition, many less tangible uses occur, such as the viewing of scenery, a recreational experience, a glimpse of some wildlife species, or even the satisfaction by someone far-removed from Arizona in realizing that such an area exists. These activities can be considered "uses" in the sense that areas of land are devoted to them. It can be seen that the kinds of uses for this area might be unlimited, and their evaluation unending, and like Dostoevski's underground man, whose appreciation of the endless depths of every question rendered him unfit for any action, we might never arrive at any decisions. The study team decided to use a list of broad uses which lumped them according to their effects on the land. These were the uses which were evaluated:

Near Natural Uses - This includes any land uses involving a minimum of land disturbance and where the emphasis is on preserving or enhancing the natural qualities of the area. Examples are scenic areas, wilderness, research, natural areas, some water influence zones, etc.

Wildlife Habitat - The enhancement of habitat conditions for any significant species or group of wildlife. Measures may include such things as vegetative manipulation, area protection, and modification of other land use practices.

Watershed Development - Measures to increase or regulate water yields, or to improve the efficiency of on-site water use by plants.

Watershed Protection - Measures to control or prevent erosion, or the protection of areas to prevent degradation of watershed values.

Grazing - The development and use of forage for domestic animals on a sustained yield basis.

Recreation Use - The use of an area by people for recreational purposes without special structures.

Recreation Development - The development of sites with facilities to support recreational uses.

Silviculture - Managing for the production of timber crops on a sustained yield basis.

Land Occupancy - The use of land area for any permanent structure which precludes other wildland uses on that site.

B. Effects of Uses

The effect of emphasizing each of these uses will differ for each LRU, depending on its characteristics and potential. The effects will also be apparent in differing ways, such as changes to the land, or to values produced by the land. Our analysis used changes to the following values as a measure of the effect of emphasizing each use.

Soil Productivity - The qualities which soil has to produce vegetation or other values on a sustained basis.

Water Quality - Water with desirable qualities for use on site by the ecosystem or downstream for other purposes.

Natural Beauty - The beauty which exists in or is formed by nature or man, which is in close harmony with the natural surroundings.

Amenity Values - Natural qualities of the environment which are esteemed by people (e.g., wilderness, open space, quality air, indigenous wildlife, climatic relief, recreational experiences, cultural values, etc.).

Water Productivity - Optimum yields of usable water, as a commodity.

Game and Fish - Wild animals and fish as a source of food and sport.

Wood - Timber and other products of the forest, as a commodity.

Economic Activity - The economic base of a region, including such things as efficient outputs of goods and services, employment, personal income, and reasonable growth.

Livestock Forage - Herbage available for use by domestic livestock.

By evaluating the net effect (positive or negative) of emphasizing each of the uses on each of the values, the study team developed a list of uses for each LRU in each of the following categories:

Well Adapted - The net effect of this use on this site is predominantly positive, and any detrimental effects of this use can be eliminated with normal management precautions.

Some Constraints Needed - The net effect of this use on this site is positive. Detrimental effects which have been identified can either be eliminated through special precautions, or can be considered as a trade off for the benefit received.

Difficult or Undesirable - The site is either incapable of supporting this use, or the net effect of the use is negative. Very stringent precautions would be needed to permit this kind of use, and it is not likely that uncorrected adverse effects could be justified as a trade off.

C. Areas With Similar Suitabilities

It was found in the analysis that several of the LRU's had very similar characteristics in terms of the effects each use would have. These LRU's were, therefore, grouped together into areas

with distinctive use suitabilities. The following table is a summary of these areas, which are also shown on a map in the Appendix. It should be emphasized that these are broad, generalized units, which, while they have strong uniformity in many characteristics, may have small areas within them where certain uses could be permitted, but not in the area as a whole. For example, a suitable site for a 20 acre campground might be found within a 100,000 acre unit where recreation site development is listed as being undesirable.

This map can be used to judge, in a general way, the risk of land damage, and the feasibility of certain uses within the potential and limitations of the site. This evaluation does not suggest that certain uses should be planned for, or prohibited on the locations shown. It merely reveals broad areas within which there are lands which meet the criteria that have been selected. Once areas have been chosen for particular uses (as a final result of this planning process), further evaluation and planning for each area will be necessary to properly develop each resource, and to specify the measures necessary to preserve other important values on that site.

A summary of the possible effects of emphasizing each resource use on each of the areas follows this chapter. These summaries illustrate the factors considered in judging whether or not each area is suitable for any resource use.

Summary of

RESOURCE USE SUITABILITIES

	Map Area	Acres	Land Sensitivity	Land Capability	Natural Beauty	Grazing	Land Occupancy	Near-Natural Uses	Recreation Site Development	Recreation Use	Silviculture	Watershed Development	Watershed Protection	Wildlife Habitat Management
						RESOURCE USES								
Amenity Values	A	137,000	High	Low-Med.	Med-High	●	●	○	●	◒	●	●	◒	◒
	B	6,000	High	High	Medium	◒	●	○	●	●	●	○	○	○
	C	31,700	Med-High	Low-Med	Medium	●	●	○	●	◒	●	◒	○	○
Amenity Values and Commodity Production	D	58,900	Med.	Low	Low	◒	●	◒	●	◒	◒	◒	◒	○
	E	72,200	Med-High	Med-High	Medium	◒	●	◒	●	◒	◒	○	◒	○
	F	41,700	Low-Med	Med-High	Medium	○	●	◒	◒	○	○	○	◒	○
	G	75,000	Med-High	Medium	Medium	◒	●	○	◒	◒	◒	○	○	○
	H	83,700	Med.	Medium	Medium	◒	●	◒	●	◒	○	○	◒	○
	I	57,000	Med.	Low	Low	◒	◒	◒	◒	◒	●	◒	◒	○
Commodity Production	J	13,500	Low	Med-High	Low-Med.	○	◒	◒	◒	○	●	◒	◒	◒
	K	175,100	Low-Med.	Med-High	Low-Med.	◒	●	●	◒	◒	○	○	◒	○

○ Well Adapted

◒ Some Constraints Needed

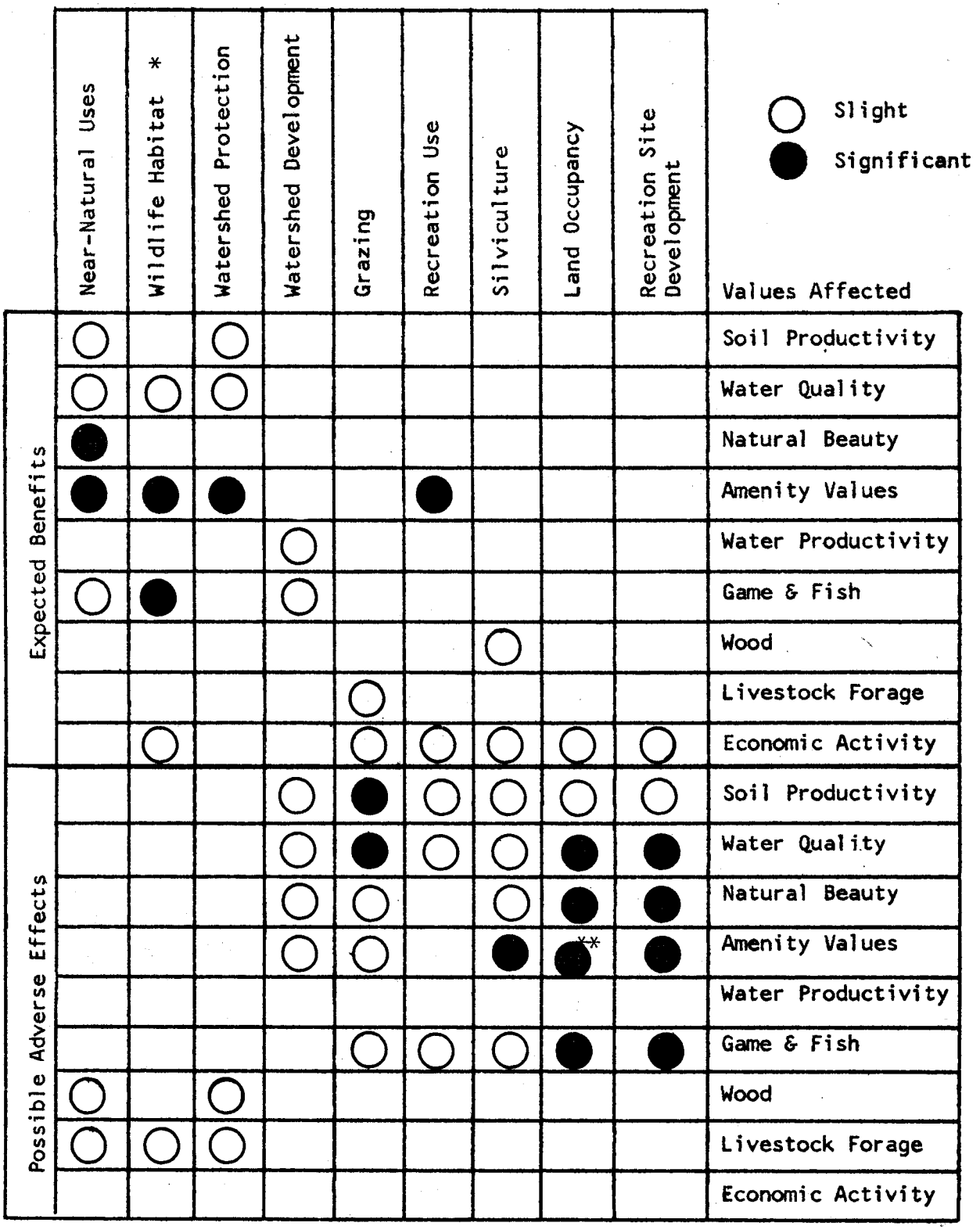
● Undesirable or Difficult

Mogollon Rim Area

Land Use Planning Study

POSSIBLE EFFECTS OF RESOURCE USE

Map Area A



* Fisheries

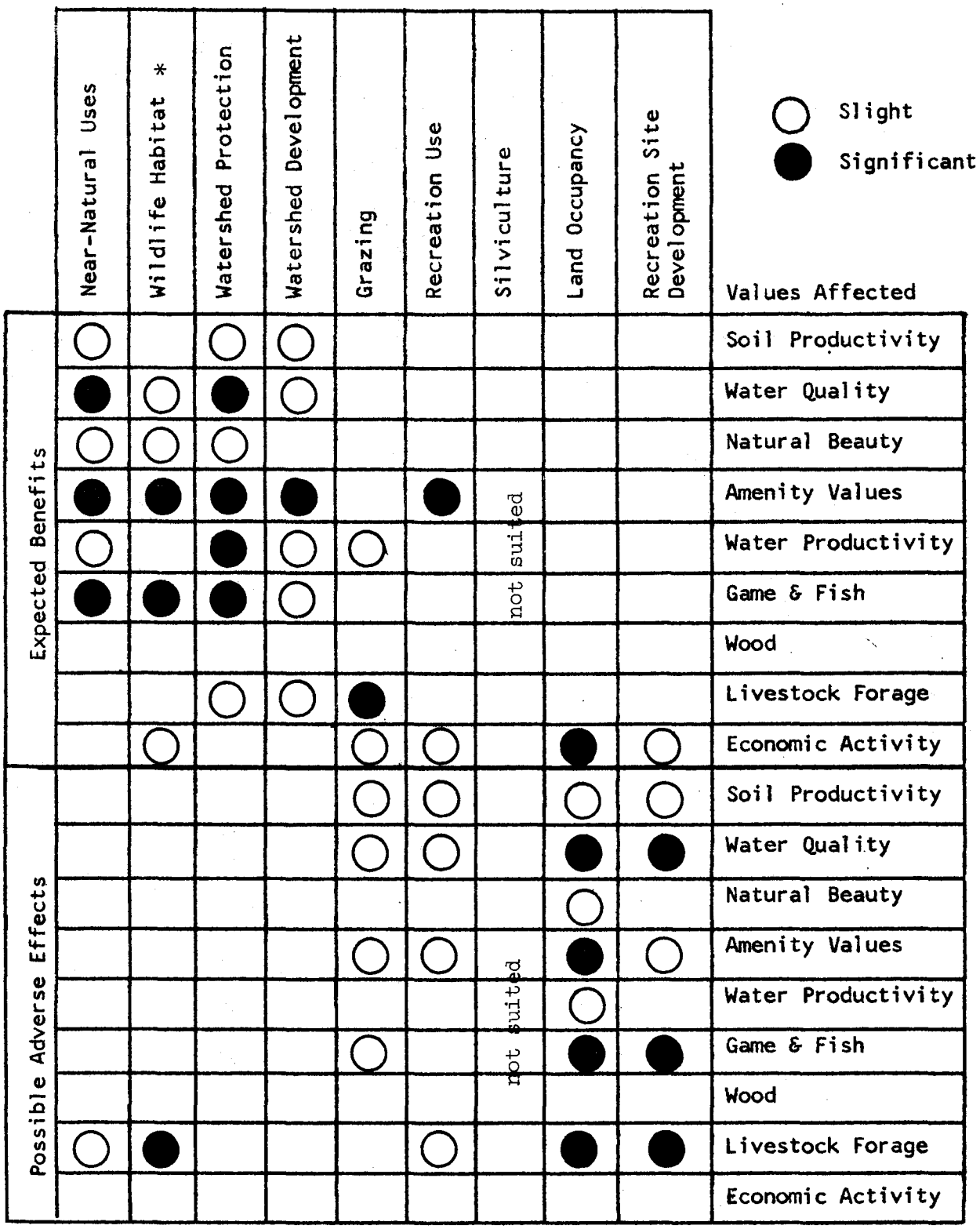
** Archeologic Sites

Mogollon Rim Area

Land Use Planning Study

POSSIBLE EFFECTS OF RESOURCE USE

Map Area B



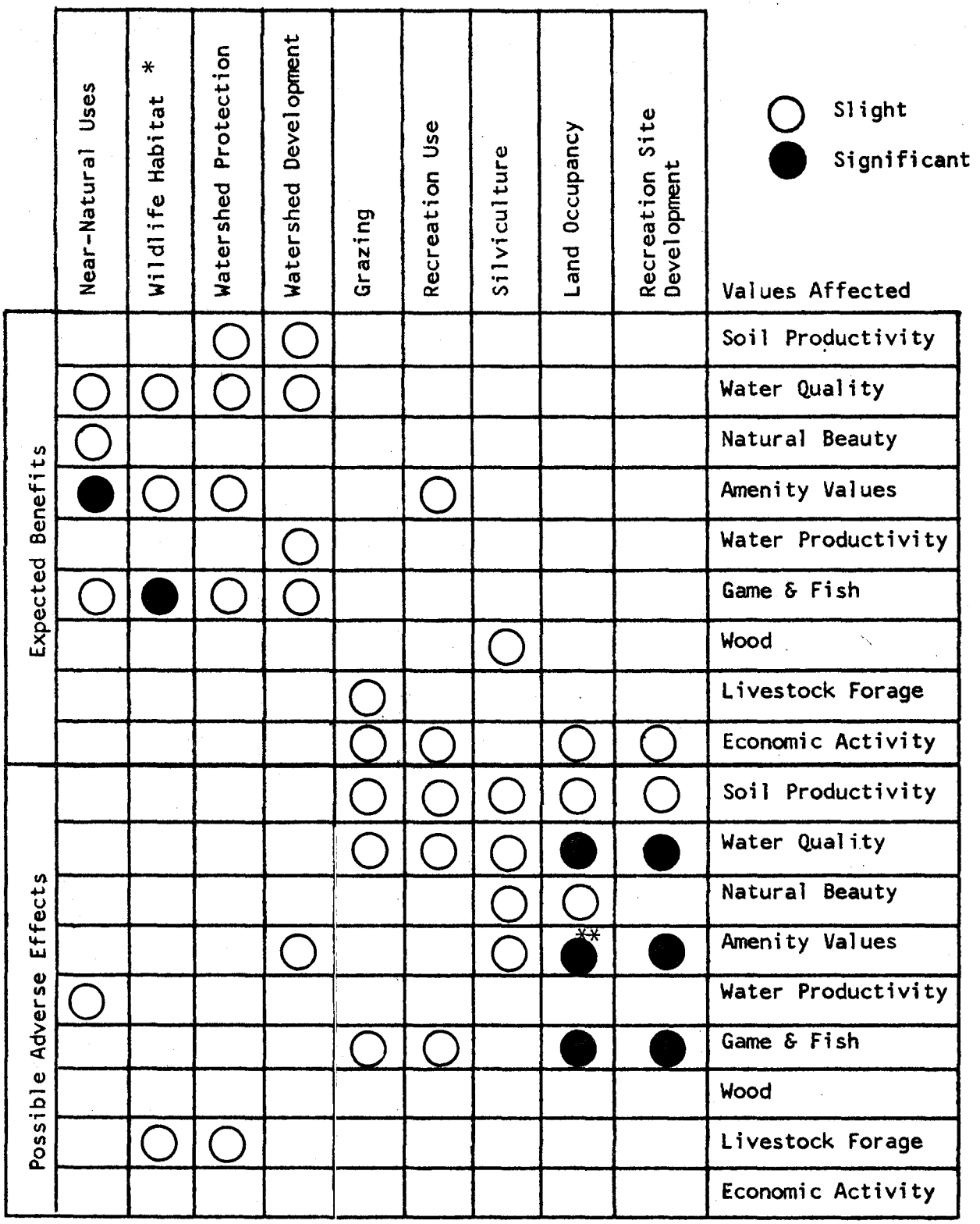
* Elk, Turkey

Mogollon Rim Area

Land Use Planning Study

POSSIBLE EFFECTS OF RESOURCE USE

Map Area C



* Mule deer, band-tails, song birds

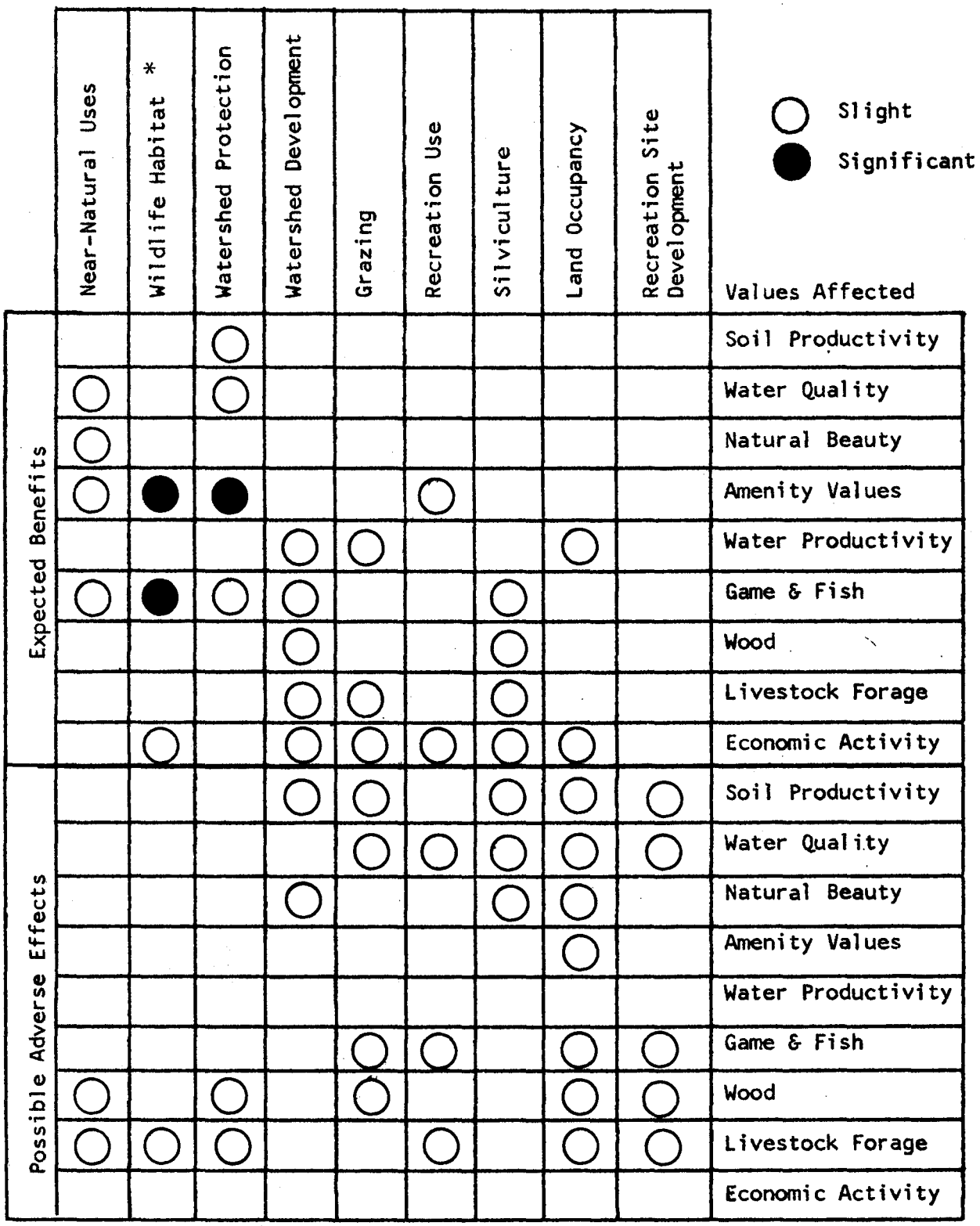
** Archeologic Sites

Mogollon Rim Area

Land Use Planning Study

POSSIBLE EFFECTS OF RESOURCE USE

Map Area D



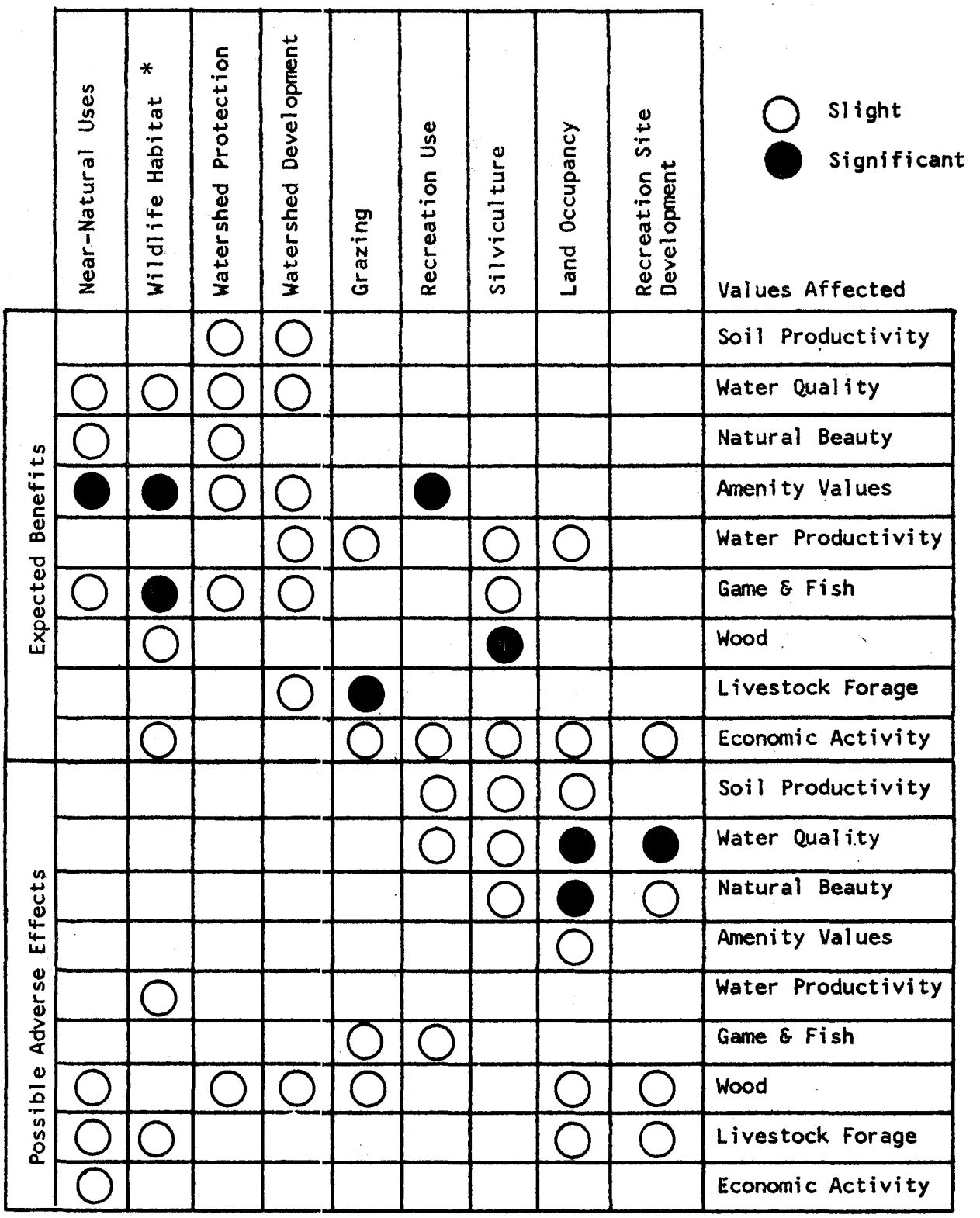
* White-tail deer, elk, turkey, band-tails

Mogollon Rim Area

Land Use Planning Study

POSSIBLE EFFECTS OF RESOURCE USE

Map Area E



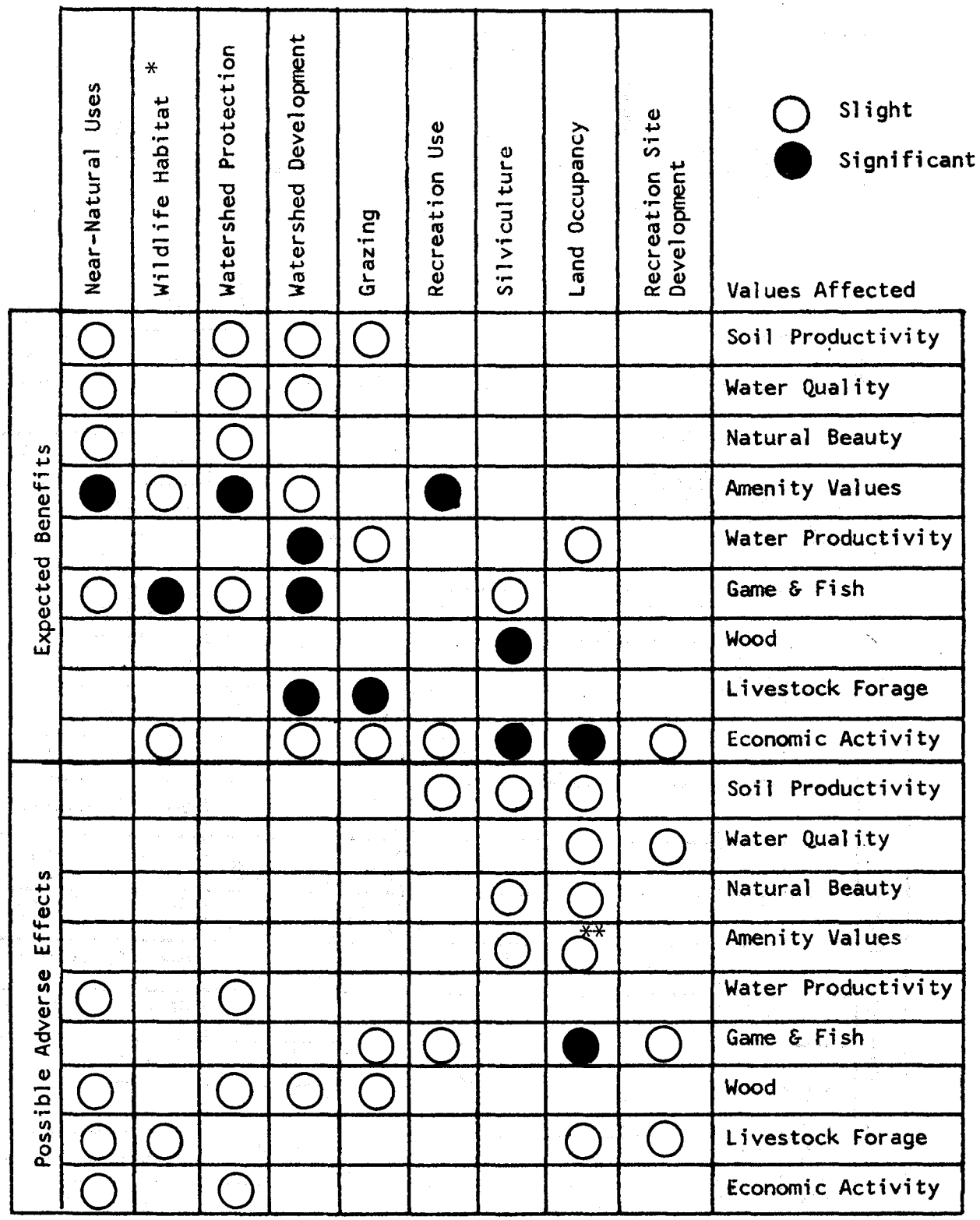
* Elk, mule deer, turkey, Abert squirrel

Mogollon Rim Area

Land Use Planning Study

POSSIBLE EFFECTS OF RESOURCE USE

Map Area F

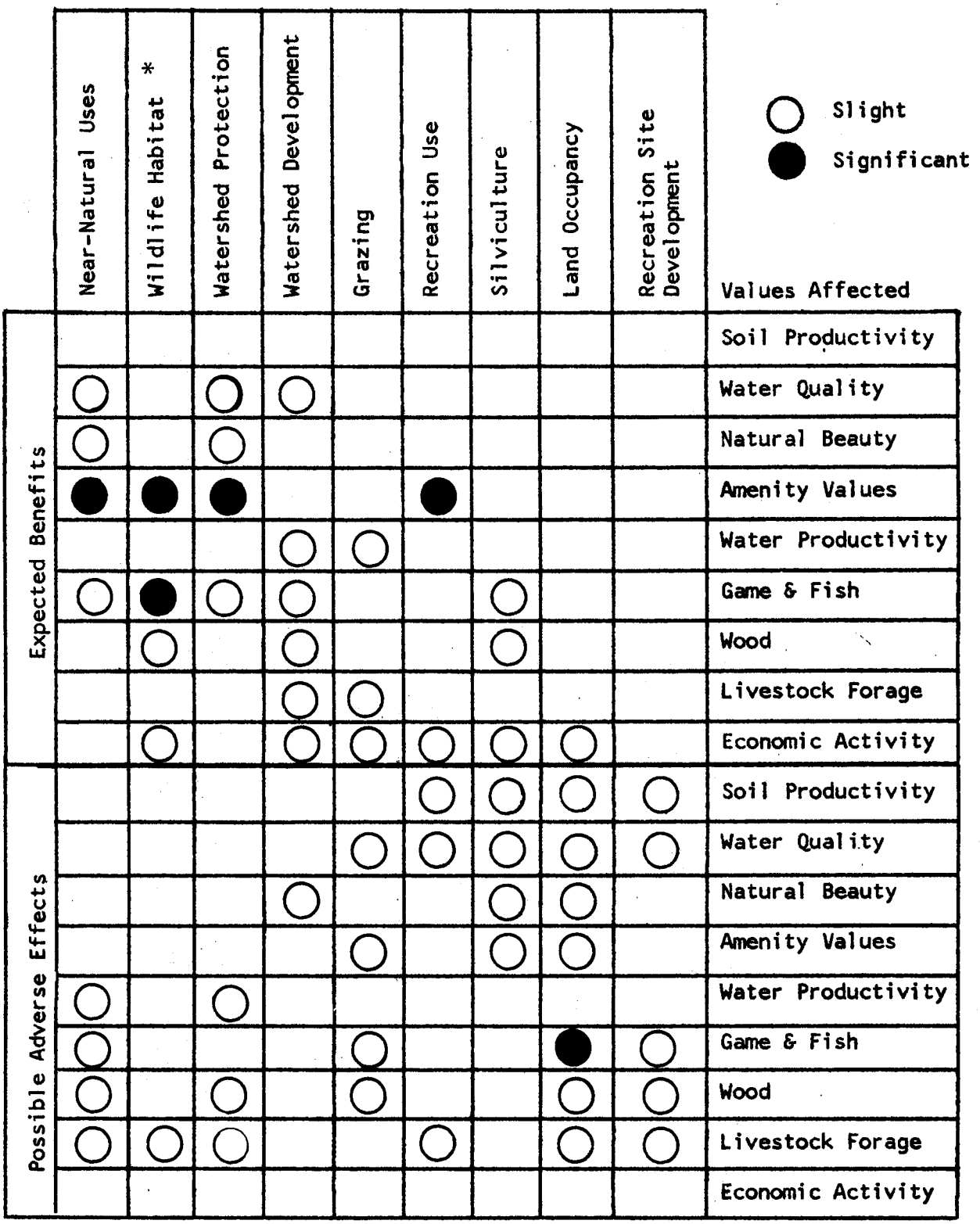


* Elk, mule deer, turkey, gray squirrel ** Archeoligic Sites

Land Use Planning Study

POSSIBLE EFFECTS OF RESOURCE USE

Map Area G



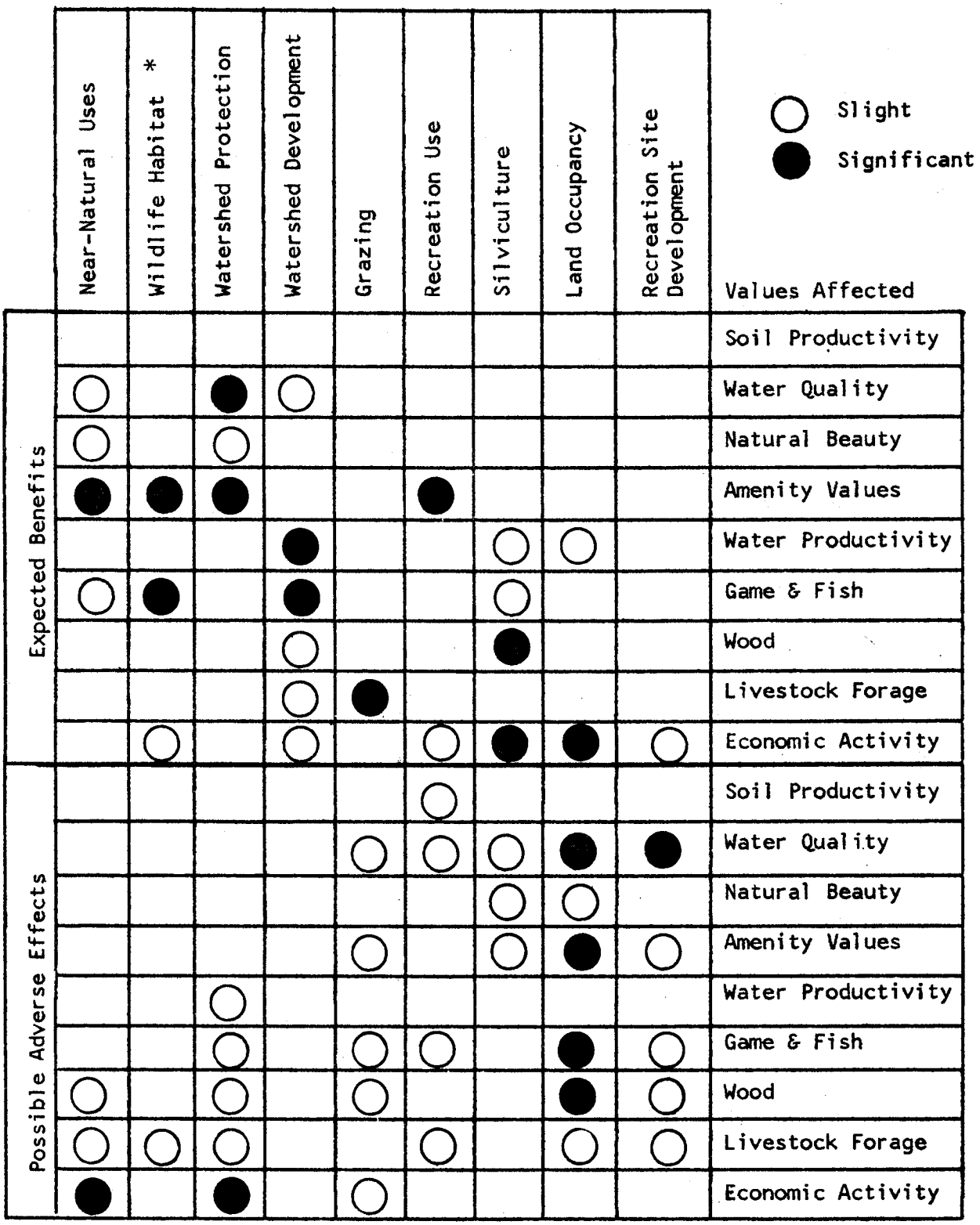
* Elk, mule deer, Abert and red squirrel, band-tails

Mogollon Rim Area

Land Use Planning Study

POSSIBLE EFFECTS OF RESOURCE USE

Map Area H



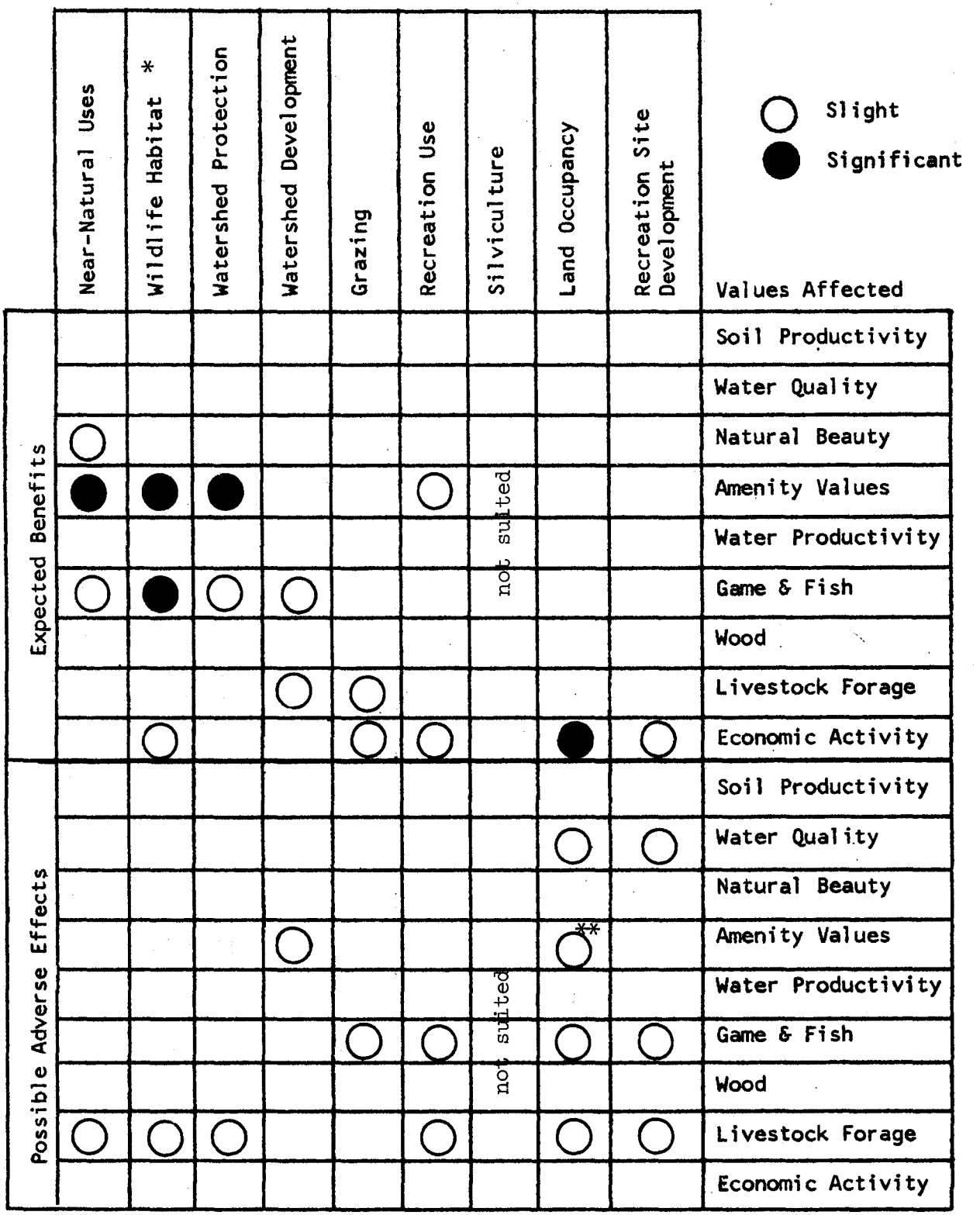
* Turkey, mule deer, band-tails, Abert squirrel

Mogollon Rim Area

Land Use Planning Study

POSSIBLE EFFECTS OF RESOURCE USE

Map Area I



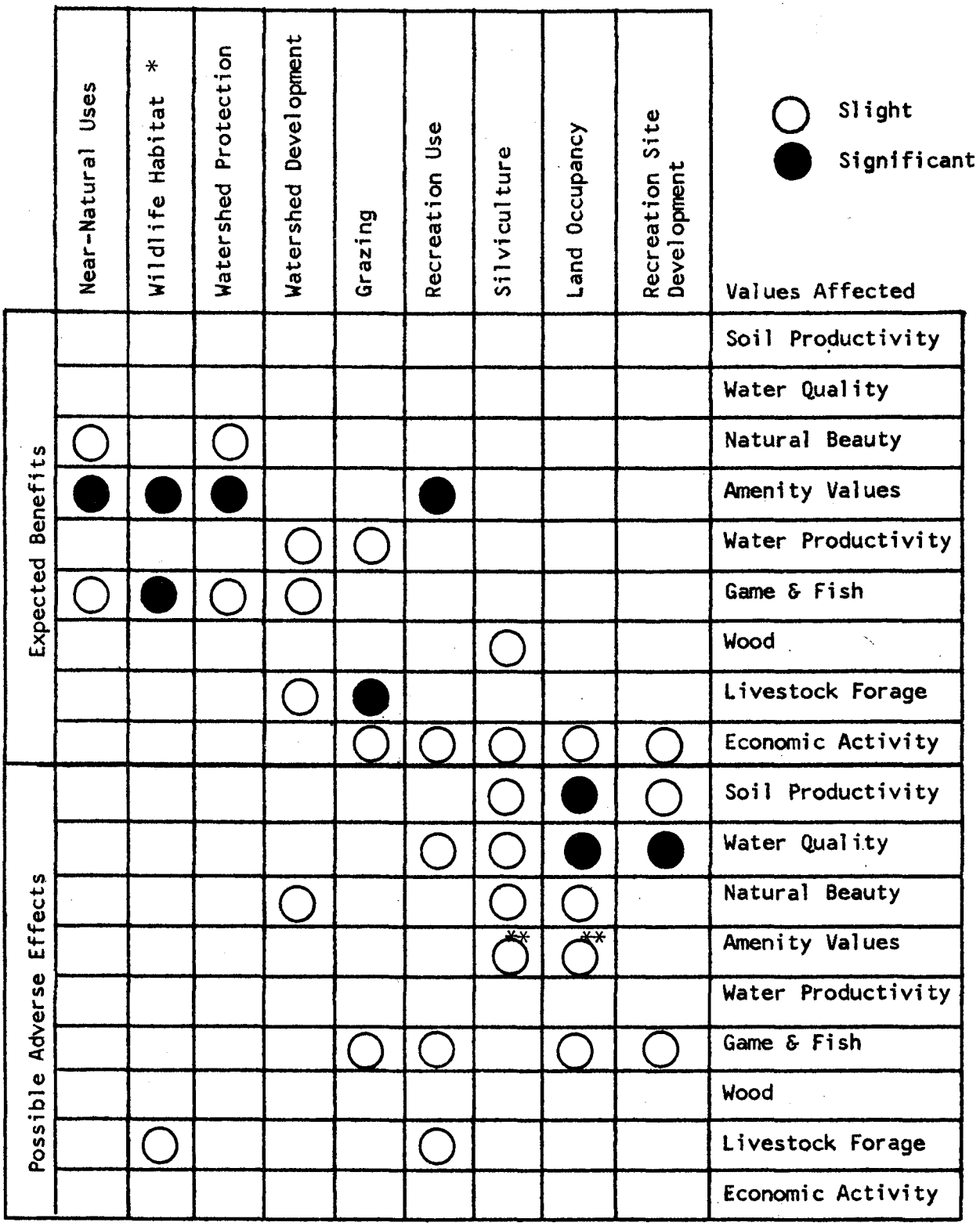
* Elk, mule deer, turkey, prong-horn ** Archeologic Sites

Mogollon Rim Area

Land Use Planning Study

POSSIBLE EFFECTS OF RESOURCE USE

Map Area J



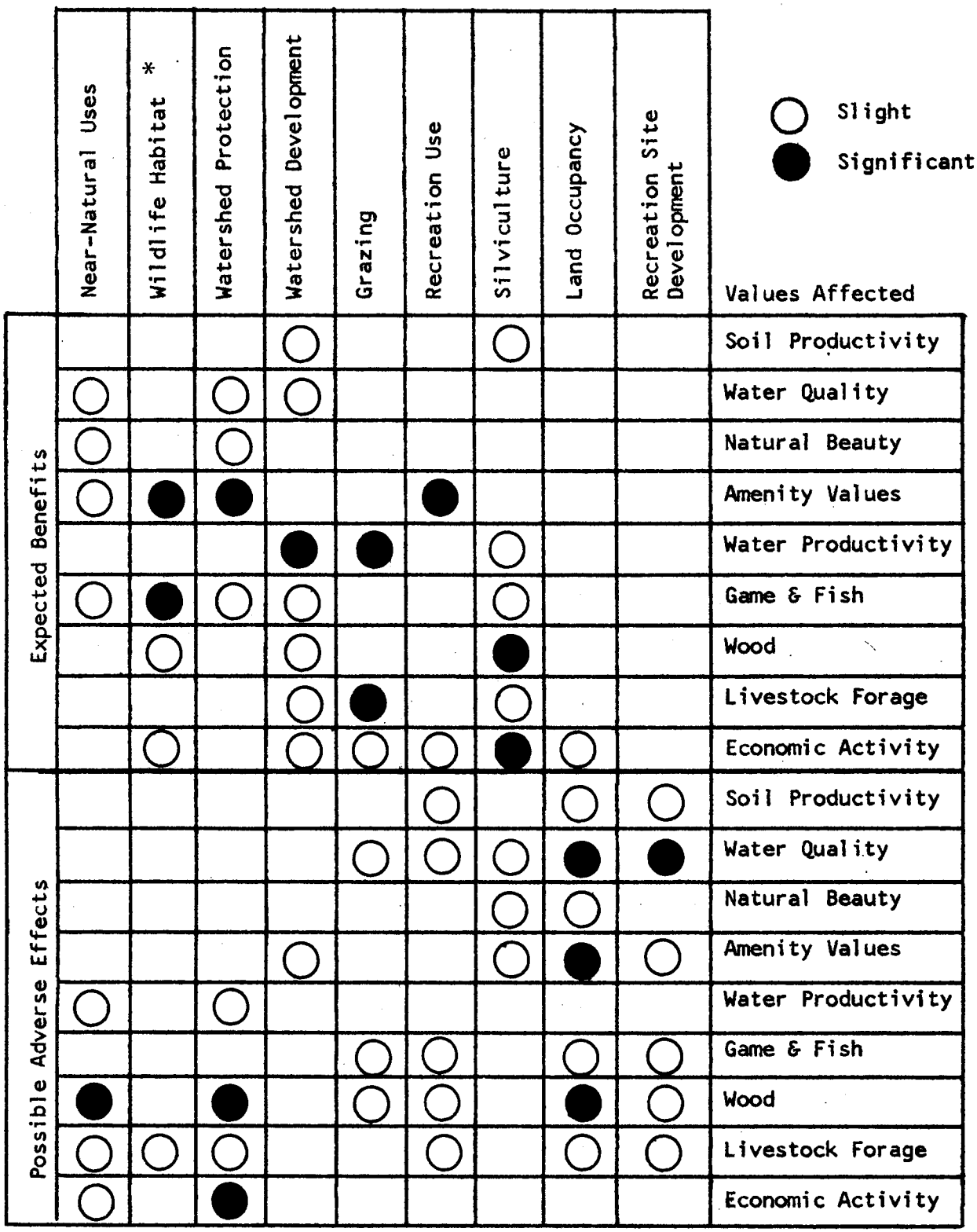
* Mule deer, cotton-tail, band-tails ** Archeologic Sites

Mogollon Rim Area

Land Use Planning Study

POSSIBLE EFFECTS OF RESOURCE USE

Map Area K



* Elk, turkey, Abert squirrel, mule deer

RESOURCE USE SUITABILITIES

Well Adapted ○ Some Constraints Needed ◒ Undesirable or Difficult ●

	Map Area	Acres	Land Sensitivity	Land Capability	Natural Beauty	Grazing	Land Occupancy	Near-Natural Uses	Recreation Site Development	Recreation Use	Silviculture	Watershed Development	Watershed Protection	Wildlife Habitat Management
Amenity Values	A	137,000	High	Low-Med.	Med-High	●	●	○	●	◒	●	●	◒	◒
	B	6,000	High	High	Medium	◒	●	○	●	●	●	○	○	○
	C	31,700	Med-High	Low-Med	Medium	●	●	○	●	◒	●	◒	○	○
Amenity Values and Commodity Production	D	58,900	Med.	Low	Low	◒	●	◒	●	◒	◒	◒	◒	○
	E	72,200	Med-High	Med-High	Medium	◒	●	◒	●	◒	◒	○	◒	○
	F	41,700	Low-Med	Med-High	Medium	○	●	◒	◒	○	○	○	◒	○
		75,000	Med-High	Medium	Medium	◒	●	○	◒	◒	◒	○	○	○
		83,700	Med.	Medium	Medium	◒	●	◒	●	◒	○	○	◒	○
		57,000	Med.	Low	Low	◒	◒	◒	◒	◒	●	◒	◒	○
Commodity Production	J	13,500	Low	Med-High	Low-Med.	○	◒	◒	◒	○	●	◒	◒	◒
	K	175,100	Low-Med.	Med-High	Low-Med.	◒	●	●	◒	◒	○	○	◒	○

ANALYSIS

The lands of the Mogollon Rim Area are characterized by extreme variations in soil, climate, natural drainage, vegetation, and other factors. These lands have definite limits for use, beyond which productivity declines, erosion sets in, and other desirable qualities tend to deteriorate. These limits are physical and biological, and will be different for each area of land, depending on the characteristics of that area of land, and on the kinds of resource uses which are being considered. This map summarizes the results of an analysis of the possible effects of resource uses occurring on areas of differing characteristics. It takes into account the capability of each area to withstand some kinds of resource use, the potential of each area to produce these resource values at a reasonable cost (economic and social) under the principle of sustained-yield, and considers the constraints necessary to ensure that other resources and values are protected. This kind of analysis is intended to serve as a tool in proposing possible land uses for the Mogollon Rim Area.

USES CONSIDERED

An area as well endowed with the variety of landforms, vegetation, and climate as is the Rim Area, is adapted to the production of a wide variety of benefits of value. We have lumped together many kinds of resource use into the following broad categories for evaluation:

Near-Natural Uses - This includes any land uses involving a minimum of land disturbance, where the emphasis is on protecting or enhancing the natural characteristics of the area. Examples are scenic areas, wilderness, research natural areas, some travel and water influence zones, etc.

Wildlife Habitat - The enhancement of habitat conditions for any significant species or group of wildlife. Measures may include such things as vegetative manipulation, area protection, and special modifications of other land use practices.

Watershed Protection - Measures to control or prevent erosion, or the protection of areas to prevent degradation of watershed values.

Grazing - The development and use of forage for grazing by domestic animals on a sustained yield basis.

Recreation Use - The use of an area by people for recreational purposes without special structures.

Recreation Development - The development of sites with special facilities to support recreational uses.

Silviculture - The practice of controlling the establishment, composition, constitution, and growth of forests for forest crops.

Watershed Development - Measures to increase or regulate water yields, or to improve the efficiency of on-site water use.

Land Occupancy - The use of land area for any permanent structure which precludes other wildland uses on that site.

EFFECTS OF USES

The effect of each land use will differ for each area, depending on its characteristics and potential. The effects will also be apparent in differing ways, such as by changes to the land, or to values produced by the land. Our analysis used changes to the following values as a measure of the effect of emphasizing each use.

Soil Productivity - The qualities which soil has to produce vegetation or other values on a sustained basis.

Water Quality - Water with desirable qualities for use on site by the ecosystem or downstream for other purposes.

Amenity Values - Natural qualities of the environment which are esteemed by people (e.g., wilderness, open space, quality air, indigenous wildlife, climatic relief, recreational experiences, cultural values, etc.).

Water Productivity - Optimum yields of usable water, as a commodity.

Game and Fish - Wild animals and fish as a source of food and sport.

Wood - Timber and other products of the forest, as a commodity.

Economic Activity - The economic base of a region, including such things as efficient outputs of goods and services, employment, personal income, and reasonable growth.

Livestock Forage - Herbage available for use by domestic livestock.

CONCLUSIONS

An evaluation of the possible net effect (positive or negative), permitted the study team to draw conclusions about the suitability of each area for each of the kinds of resource use. These have been summarized above into the following categories.

Area Well Adapted - The net effect of this use on this site is predominantly positive, any detrimental effects can be eliminated with normal management precautions.

Some Constraints Needed - The net effect on this site is positive. Detrimental effects can either be eliminated through special precautions, or can be considered as a reasonable trade-off for the benefit received.

Undesirable or Difficult - The site is either incapable of supporting this use, or the net effect is likely to be negative. Stringent precautions would be needed to permit this kind of use, and it is not likely that detrimental effects would be acceptable as a trade-off for possible benefits.

It should be emphasized that the areas shown on this map are broad generalized lumpings of more detailed information. While the areas shown have a strong uniformity in many characteristics, they contain many smaller sites with contrasting suitabilities for use, which are not common to each area as a whole. For example, a suitable site for a small campground might be found within a large area where recreation site development is listed as being undesirable.

Flagstaff

Winslow

Highway 87

Blue Ridge Reservoir

Chevelon Canyon Lake

Knoll Lake

Bear Canyon Lake

Willow Springs Lake

Woods Canyon Lake

Black Canyon Lake

HEBER

Snowflake

OVERGAARD

STRAWBERRY

PINE

STAR VALLEY

PAYSON

Highway 260

Highway 87

Phoenix

YOUNG

1 0 1 2 3 4

Scale in Miles

IX. *Appendix*

CHECKLIST OF MAMMALS OF MOGOLLON RIM AREA

SORICIDAE	Shrews
Sorex merriami	Merriam shrew
Sorex vagrans	vagrant shrew
Notiosorex crawfordi	desert shrew
VESPERTILIONIDAE	Plainnose bats
Myotis yumanensis	Yuma myotis
Myotis velifer	cave myotis
Myotis occultus	Arizona myotis
Myotis evotis	long-eared myotis
Myotis thysanodes	fringed myotis
Myotis volans	long-legged myotis
Myotis californicus	California myotis
Myotis subulatus	small-footed myotis
Pipistrellus hesperus	western pipistrel
Eptesicus fuscus	big brown bat
Lasionycteris noctivagans	silver-haired bat
Lasiurus cinereus	hoary bat
Euderma maculata	spotted bat
Plecotus townsendii	western big-eared bat
Plecotus phyllotis	Mexican big-eared bat
Antrozous pallidus	pallid bat
MOLOSSIDAE	Freetail bats
Tadarida brasiliensis	Mexican freetail bat
Tadarida macrotis	big freetail bat
URSIDAE	Bears
Ursus americanus	black bear
PROCYONIDAE	Raccoons
Procyon lotor	raccoon
Nasua narica	chula; coati mundi
BASSARISCIDAE	Ringtail cats
Bassariscus astutus	ringtail cat
MUSTELIDAE	Weasels, skunks, badgers
Mustela frenata	longtail weasel
Lutra canadensis	river otter
Spilogale gracilis	spotted skunk
Mephitis mephitis	striped skunk
Conepatus mesoleucus	hognose skunk
Taxidea taxus	badger

CANIDAE	Coyote and foxes
Vulpes macrotis	kit fox
Urocyon cinereoargentius	gray fox
Canis latrans	coyote
FELIDAE	Cats
Felis concolor	mountain lion
Lynx rufus	bobcat
SCIUIDAE	Squirrels
Citellus variegatus	rock squirrels
Citellus harrisi	Yuma antelope squirrel
Citellus lateralis	golden-mantled squirrel
Eutamias cinereicollis	gray neck chipmunk
Eutamias dorsalis	cliff chipmunk
Tamiasciurus hudsonieus	red squirrel
Sciurus arizonensis	Arizona gray squirrel
Scuirus aberti	Tassel-eared squirrel
GEOMYIDAE	Pocket gophers
Thomomys bottae	valley pocket gopher
HETEROMYIDAE	Pocket mice
Perognathus amplus	Arizona pocket mouse
Perognathus intermedius	rock pocket mouse
Dipodomys ordii	Ord kangaroo rat
CASTORIDAE	Beavers
Castor canadensis	beaver
CRICETIDAE	New World rats and mice
Onychomys leucogaster	Northern grasshopper mouse
Onychomys torridus	Southern grasshopper mouse
Reithrodontomys megalotis	Western harvest mouse
Peromyscus maniculatus	deer mouse
Peromyscus eremicus	cactus mouse
Peromuscus leucopus	white-footed mouse
Peromyscus boylii	brush mouse
Peromyscus truei	pinyon mouse
Sigmodon hispidus	hispid cotton rat
Neotoma albigula	whitethroat woodrat
Neotoma mexicana	Mexican woodrat
Neotoma stephensi	Stephen's woodrat

Microtus longicaudus	longtail vole
Microtus mexicanus	Mexican vole
Ondatra zibethica	muskrat
MURIDAE	Old World rats and mice
Mus musculus	house mouse
ERETHIZONTIDAE	Porcupines
Erethizon dorsatum	porcupine
LEPORIDAE	Hares and rabbits
Lepus californicus	blacktail jackrabbit
Sylvilagus nuttalli	mountain cottontail
Sylvilagus auduboni	desert cottontail
Sylvilagus floridanus	Eastern cottontail
TAYASSUIDAE	Peccaries
Tayassu tajacu	javelina
CERVIDAE	Deer
Cervus canadensis	elk
Odocoileus hemionus	mule deer
Odocoileus virginianus	whitetail deer
ANTILOCAPRIDAE	Pronghorn
Antilocapra americana	pronghorn

CHECKLIST OF BIRDS 1/
PAYSON, ARIZONA

Turkey Vulture

Sharp-Shinned Hawk

Rough-legged Hawk

Pigeon Hawk

Turkey (Control Road)

Snowy Egret (Golf Pond)

White-Faced Ibis (Golf Pond)

American Coot (Golf Pond)

Killdeer

Lesser Yellowlegs (Golf Pond)

Least Sandpiper (Golf Pond)

Band-Tailed Pigeon

White-Winged Dove

Roadrunner

Poor Will

Black-Chinned Hummingbird

Belted Kingfisher (Golf Pond)

Gila Woodpecker (near Roosevelt)

Acorn Woodpecker

Hairy Woodpecker

Western Kingbird

Ash-Throated Flycatcher

Black Phoebe

Barn Swallow

Rough-Winged Swallow

Steller's Jay

Cooper's Hawk

Marsh Hawk

Red-Tailed Hawk

Sparrow Hawk

Gambel's Quail

Great Blue Heron (Golf Pond)

Black Rail (Golf Pond)

Black-Necked Stilt (Golf Pond)

Greater Yellowlegs (Golf Pond)

Long-Billed Dowitcher (Golf Pond)

Wilson's Phalarope (Golf Pond)

Rock Dove

Mourning Dove

Great Horned Owl (Nail Ranch, near Young)

Common Nighthawk

Rufous Hummingbird

Red-Shafted Flicker

Ladder-Backed Woodpecker (near Roosevelt)

Yellow-Billed Sapsucker

Vermilion Flycatcher

Cassin's Kingbird

Olivaceous Flycatcher

Say's Phoebe

Violet-Green Swallow

Purple Martin (Ponderosa Springs)

Scrub Jay

1/ Compiled by Ray and Margaret Schmidt, Payson, Arizona.

Mexican Jay

Common Raven

Black-Capped Chickadee

Bridled Titmouse

Common Bushtit

White-Breasted Nuthatch

Brown Creeper (On Rim)

Bewick's Wren

Canyon Wren

Bendire's Thrasher (Roosevelt)

Robin

Western Bluebird

Blue-Gray Gnatcatcher (Roosevelt)

Cedar Waxwing

Starling

Black-and-White Warbler

Yellowthroat

Painted Redstart (Whispering Pines)

Western Meadowlark

Red-Winged Blackbird

Brewer's Blackbird

Brown-Headed Cowbird

Scott's Oriole

Baltimore Oriole

Western Tanager

Rose-Breasted Grosbeak

Blue Grosbeak

Varied Bunting

Pinyon Jay

Common Crow

Mountain Chickadee

Verdin (Roosevelt)

Black-Eared Bushtit (Ponderosa Springs)

Red-Breasted Nuthatch

House Wren

Cactus Wren (Road to Roosevelt and Valley)

Mockingbird

Crissal Thrasher

Townsend's Solitaire

Mountain Bluebird

Ruby-Crowned Kinglet

Phainopepla

Solitary Vireo

Audubon's Warbler (on Rim and Hill)

Yellow-Breated Chat

House Sparrow

Yellow-Headed Blackbird

Tri-Colored Blackbird

Boat-Tailed Grackle

Bronzed Cowbird

Hooded Oriole

Bullock's Oriole

Cardinal

Black-Headed Grosbeak

Lazuli Bunting

Purple Finch

Cassin's Finch

Lesser Goldfinch

Rufous-Sided Towhee

Lark Sparrow

Slate-Colored Junco

Gray-Headed Junco

Chipping Sparrow (Whispering Pines)

Harris' Sparrow

Fox Sparrow (Roosevelt)

Eared Grebe

Double-Crested Cormorant (Roosevelt)

Mallard

American Widgeon

Cinammon Teal

Redhead

Bufflehead

Ring-Billed Gull (Roosevelt)

House Finch

Green-Tailed Towhee

Brown Towhee

Black-Throated Sparrow

Oregon Junco

Tree Sparrow

Brewer's Sparrow

White-Crowned Sparrow

Western Grebe (Roosevelt Lake)

Pied-Billed Grebe

Canada Goose

Pintail

Blue-Winged Teal

Green-Winged Teal

Ring-Necked Duck

Ruddy Duck

Franklin's Gull

AQUATIC RESPONSE UNITS

MOGOLLON RIM STUDY STREAM-COURSES

Name	Size	Duration of Flow	Temperature	Turbidity	Aesthetics	Chemical Constituents	Biological	Channel			Topographic Setting
								Stability	Gradient	Streambanks	
Chevelon Creek	Large	1	1	1	1	D.O. 6-10 PPM ph 8.4 TDS 70 PPM Alkalinity (MO) 60-140 PPM	1	2	3	2	1
West Chevelon	Small	4		3	2	No data		2	3	2	1
Willow Creek	Medium	2	1	3	1	No data	2	2	3	2	1
Bear Canyon (Sit.)	Small	4		3	1	No data			3	2	2
Beaver Canyon	Small	4		3	1	No data			3	2	2
Turkey Creek	Small	4		3	1	No data			3	2	2
Gentry Canyon	Small	4		3	1	No data			3	2	2
Leonard Canyon	Large	2	1	3	1	No data	2	2	3	2	1
Clear Creek	Large	1	1	1	1	D.O. 6.6 PPM Fe-50 PPM ph 8.1 Mn 80 PPM TDS 170 PPM	1	2	3	2	1
Barbarshop Canyon	Medium	2	1	1	1	No data	1	2	3	2	2
Yeager Canyon	Medium	3		3	1	No data			3	2	2
Dane Canyon	Small	3		3	1	No data			3	2	2
Bear Canyon (Coc)	Small	3		3	1	No data			3	2	2
General Springs	Medium	2	1	3	1	No data	2	2	3	2	2
Fred Haught	Small	3		3	1	No Data			3	2	2

Name	Size	Duration of Flow	Temperature	Turbidity	Aesthetics	Chemical Constituents	Biological	Channel			Topographic Setting
								Stability	Gradient	Streambanks	
Canyon Creek	Large	1	1	1	1	D.O. 10.8 PPM Fe 85.3 PPM ph 8.4 TDS 206 PPM	1				
Haigler Creek	Medium	1	1			D.O. 13.0 PPM Fe 27.0 PPM ph 8.2 TDS 138 PPM	1				
Tonto Creek	Large	1	1			D.O. 10.0 PPM Fe 12 PPM ph 8.0 PPM TDS 165 PPM	1				
Gordon Canyon	Small	4				No Data					
Christopher Creek	Medium	1				D.O. 9.2 PPM Fe 15.5 PPM Ph 8.4 Mn 1.3 PPM TDS 9.0 PPM	1				
See Canyon	Small	4	No Data								
Hunter Creek	Small	4	No data								
Horton Creek	Medium	1	No data								
Dick Williams Creek	Small	4	No data								
Ellison Creek	Small	4	No data								
Hells Gate Canyon	Small	4	No data								
Perley Creek	Small	4	No data								
Bonita Creek	Small	4	No data								

AQUATIC RESPONSE UNITS

MOGOLLON RIM STUDY RESERVOIRS

Name	Temper-ature	Asthetic	Turbidity	Chemical Constituents	Stage of Evolution	Size	Depth	Water Level Stability
Bear Canyon Lake	Cold	1	1	DO 13 PPM ph 7.2 TDS 28 PPM Fe P 2 PPM NO_3 2 PPM Ca 20 PP Total hardness 50 PPM	Oligotrophic	Medium	Medium	Stable
Knoll Lake	Cold	2	2	DO 7.2 PPM ph 7.6 TDS 30 PPM Fe 390 PPM Mn 130 PPM Total hardness 120 PPM Nutrients 5.5 PPM	Oligotrophic	Medium	Deep	Stable
Blue Ridge Reservoir	Cold	2	2	DO 8.5 PPM ph 6.7 TDS Fe Mn Total Hardness Nutrients	Oligotrophic	Large	Deep	Moderately Stable

AQUATIC RESPONSE UNITS

MOGOLLON RIM STUDY RESERVOIRS

Name	Temperature	Asthetics	Turbidity	Chemical Constituents	Stage of Evolution	Size	Depth	Water Level Stability
Black Canyon Lake	Cold	2	2	D.O. 6.8 PPM ph 7.4 TDS 50 PPM Fe .2 PPM P10 PPM NO_3 0 Ca 60 PPM Total hardness 60 PPM	Oligotrophic	Medium	Medium	Stable
Willow Springs Lake	Cold	1	2	D.O. 8 PPM ph 7.7 T.D.S. 28 PPM Fe P 5 PPM NO_3 Ca 20 PPM Total hardness 20 PPM	Oligotrophic	Medium	Medium	Stable
Woods Canyon Lake	Cold	3	2	D.O. 16 PPM ph 8.5 TDS 34 PPM Fe P 5 PPM NO_3 6 PPM Ca 10 PPM Total hardness 60 PPM	Oligotrophic Mesotrophic	Medium	Medium	Stable
Chevelon Canyon Lake	Cold	1	1	D.O. 10 PPM ph 8.0 TDS 40 PPM Fe .1 PPM P NO_3 Ca 15 PPM Total Hardness 40 PPM	Oligotrophic	Large	Deep	Moderately Stable

Name	Size	Duration of Flow	Temperature	Turbidity	Aesthetics	Chemical Constituents	Biological	Channel Stability	Channel Gradient	Channel Streambank	Topographic Setting
Dude Creek	Small	4	No Data								
East Verde	Large	1	1			D.O. 10.0 PPM Fe 38.0 PPM ph 7.6 Mn 9.0 PPM TDS 225 PPM	1				
Chase Creek	Small	4	No Data								
Bray Creek	Small	4	No Data								
Sycamore Creek	Small	4	No Data								
Webber Creek	Small	4	1			D.O. 9.0 PPM Fe 33.0 PPM ph 8.6 TDS 228 PPM	1				
Pine Canyon	Small	4	No Data								

AQUATIC RESPONSE UNITS

MOGOLLON RIM STUDY WET LANDS (Natural Ponds & Wet Meadows)

Name of Lake	Kind	Location S	T	R	Flood Pool (ac)	Depth (ft)	Total Acres	Water Stability
Barber	Natural Pond	10	13	11	.04 Ac.	2.0 Ft.	.10 Ac.	Stable
Dude	Wet Meadow	18	12	11	1.5 Ac.	.5 Ft.	5 Ac.	Unstable
Myrtle	Wet Meadow	26	12	11	.3 Ac.	.5 Ft.	10 Ac.	Unstable
Lost	Wet Meadow	25	12	11	1.5 Ac.	.5 Ft.	10 Ac.	Unstable
Lake No. 4	Wet Meadow	29	12	12	1.0 Ac.	.5 Ft.	5 Ac.	Unstable
Baker	Wet Meadow	3	12	9	.3 Ac.	1.0 Ft.	5 Ac.	Unstable
Potato	Natural Pond	1	12	9	.3 Ac.	2.0 Ft.	15 Ac.	Stable
Five Mile	Wet Meadow	10	12	8	.1 Ac.	1.0 Ft.	5 Ac.	Unstable
Horseshoe	Natural Pond	34	12	12	1.0 Ac.	2.0 Ft.	10 Ac.	Stable
Carr	Natural Pond	4	11	13	1.5 Ac.	2.0 Ft.	10 Ac.	Stable
Five Mile	Natural Pond	21	12	13	.5 Ac.	1.0 Ft.	2 Ac.	Stable
Alder	Natural Pond	34	12	13	1.0 Ac.	3.0 Ft.	5 Ac.	Unstable
Deer	Natural Pond	25	12	13	15.0 Ac.	5.0 Ft.	35 Ac.	Stable
Palomino	Natural Pond	12	11	13½	2.0 Ac	3.0 Ft.	20 Ac.	Stable
Lake No. 1	Natural Pond	31	11	14	6.0 Ac.	4.0 Ft.	30 Ac.	Stable
Lake No. 2	Natural Pond	28	11	14	2.5 Ac.	2.5 Ft.	20 Ac.	Stable
Lake No. 3	Natural Pond	30	11	14				Stable
Unnamed	Wet Meadow	30	11	14				Unstable
Moss	Natural Pond	24	10½	14				Stable
Lonesome	Natural Pond	19	10½	15				Unstable
Mosquito	Wet Meadow	33	11	14	1.0 Ac.	1.0 Ft.	5 Ac.	Stable
Aspen	Wet Meadow	33	11	14	1.5 Ac.	2.0 Ft.	10 Ac.	Stable
Hidden	Natural Pond	21	11	14				Unstable
Horse Trap	Natural Pond	21	11	14				Unstable
Jacob	Wet Meadow	22	11	14	1.0 Ac.	1.0 Ft.	5 Ac.	Stable
Nelson	Natural Pond	21	11	15				Stable
Twin	Natural Pond	3	10½	15½				Stable
Pinto	Natural Pond	15	11	14				Unstable
Aspen	Wet Meadow	16	11	15				Unstable
Unnamed	Wet Meadow	25	11	13½				Unstable
Unnamed	Natural Pond	8	11	13				Stable
Unnamed	Wet Meadow	35	12	13				Unstable
Unnamed	Natural Pond	31	12	14				Unstable
Unnamed	Natural Pond	33	11	14	2.0 Ac.	1.0 Ft.	3.0 Ac.	Stable
Unnamed	Wet Meadow	34	11	14				Unstable

STREAMCOURSES

The components used for delineating and describing streamcourses are water characteristics (quantity and quality) and physical characteristics.

I. Water Characteristics

A. Water Quantity - amount and duration of flow size classes.

1. Very small — less than 0.5 cfs.
2. Small — 0.5 - 2 cfs
3. Medium — 2 - 10 cfs
4. Large — greater than 10 cfs

B. Duration of Flow

1. Perennial - Low flow is not a problem.
2. Perennial with low flows.
3. Perennial most years - dries in 10 days or more in 10-25% of years.
4. Frequently Ephemeral - flows yearlong only in wet years. Seasonal with 9-11 months flow.
5. Ephemeral - normally flows seasonally for 3-8 months.

C. Water Quality

Water quality consists of physical, chemical and biological characteristics.

Physical

Temperature

1. Cold - Temperature rarely exceeds 70 degrees F.
2. Warm - Temperature commonly exceeds 70 degrees F.

D. Turbidity

1. Turbidity rarely exceeds 50 JTU (Jackson Turbidity Units) even after large storms.
2. Occasional turbidity in range of 5-20 JTU - commonly exceeds

50 JTU after storms.

3. Turbidity commonly exceeds 20 JTU.

E. Aesthetics (color, odor and debris)

1. Natural color, no odor and excessive amounts of debris.

2. Occasional conditions of objectionable odor, unnatural color, or excessive amounts of debris.

3. Frequent conditions of objectionable odor and/or color or large amounts of debris.

F. Chemical Characteristics

Recommended Limits - These are the criteria as established in the Water Quality Criteria, Report of the National Technical Advisory Committee to the Secretary of the Interior, April 1, 1968.

Major and Minor Constituents

Major	Minor
Dissolved oxygen	Alkalinity
ph	Sulfates
Total dissolved solids	Total hardness
Heavy metals	Nutrients

G. Biological - The following distinction is made between major groups of aquatic invertebrates.

Primary	Secondary
Mayfly	Blackfly
Caddisfly	Water beetle
Stonefly	Water bug
Dobsonfly	Midge
	Snail

Descriptions apply to the annual low flow period.

1. Invertebrate population composed of at least three groups of organisms with at least two primary groups present and comprising at least 50% of total numbers.

2. At least three groups with at least one of the primary groups present and comprising 25% or more of the total numbers.

3. Several secondary groups present but no primary groups.

4. Virtually no organisms present.

II. Physical Characteristics

Channels - Channel characteristics are described and classified with respect to stability, gradient and streambanks.

A. Stability (bottom)

1. Channel bottom very stable. Very little sediment bedload movement.

2. Channel bottom moderately stable. Some sediment bedload movement as evidenced by scouring and filling pools and bars on high flows.

3. Channel bottom unstable. Large amounts of sediment bedload movement occur every year in high flow.

B. Gradient

1. Steep > 10%

2. Moderate 2-9%

3. Gentle < 2%

C. Streambanks

1. Very stable - streambanks are either completely vegetated or rock out crops.

2. Moderately stable - some bank cutting and sloughing occur nearly every year.

3. Unstable - bank cutting and sloughing occur over a large part of the channel nearly every year.

D. Topographic Setting

1. Incised - very narrow, deep, steep-walled canyon bottoms.

2. Intermediate - drainages are at least bench or terrace above channel.

3. Exposed - wide alluvial valley.

RESERVOIRS

Many of the criteria for delineation and description of streamcourses apply also to reservoirs.

I. Water Characteristics

A. Temperatures - same criteria as for streamcourses.

B. Turbidity - same criteria as for streamcourses.

C. Aesthetics - same criteria as for streamcourses.

D. Chemical - same criteria as for streamcourses except the nutrients are major constituents in reservoirs.

E. Stage of Evolution

1. Oligotrophic - relatively sterile.

2. Mesotrophic - productive but still clean.

3. Eutrophic - quite mature.

4. Dystrophic - approaching bog or marsh.

II. Physical Characteristics

Sign Classification

Very small	1 acre or less
Small	1-20 acres
Medium	21-100 acres
Large	more than 100 acres

Depth Classification

Very small	less than 5 feet
Shallow	5-15 feet
Medium	16-50 feet
Deep	more than 50 feet

Water Level Stability

1. Stable - little annual fluctuations.

2. Moderately stable - water level commonly fluctuates from year

to year.

3. Unstable - seasonal drawdown commonly brings storage to less than 25% of capacity.

WETLANDS

Wetlands are usually very important to wildlife and are important hydrologically. Components used for delineating and describing these are as follows:

Kinds

Wet meadow

Natural pond

Location

Legal description by Section, Towhship and Range.

Size

Flood pool - size in acres of water surface when full.

Depth - depth in feet.

Total acres - area of wetland influence.

Water Stability

Stable - has water year round.

Unstable - dries up frequently during droughty periods.

MOGOLLON RIM STUDY - NATURAL BEAUTY INVENTORY CRITERIA

	High 12-9	Moderate 8-5	Low 4-1
Land-form	Severe Topographic relief from horizontal, 50% slopes. Distinctive formations present.	Moderate topographic relief,>20% to 50% slopes. Some formations present.	Flat, 0 to 20% slope. No distinctive formations present.
Vegetation	A variety of vegetation types (> 4). Interesting patterns (good harmony, balance and contrast)	Two to 4 vegetation types and patterns of vegetation.	< 2 vegetation types and few patterns.
Color	Several hues (> 4) present in vegetation, soil & rock. A variety in chroma & value. Large scale-seasonal color changes.	Three to 4 hues present in vegetation, soil & rock. Some variety in chroma & value. Localized areas of seasonal color changes.	< 3 different hues present in vegetation, soil & rock. Little difference in chroma & value. No seasonal color changes.
Water	Water generally present in the form of live streams, lakes, rain & snow.	Some water, intermittent streams, showers & snow.	Water not generally present. Arroyos & dry areas.
Effects of Man	None are present or the effects of man are in harmony (in form, line, color & texture) with the characteristic landscape.	Some of the effects of man detract from the landscape.	Many of the effects of man detract from the landscape

SCORE CARD

Item	Rate	Remarks (outstanding + or - features)
Land		
Veg		
Color		
Water		
Man		
Total	——— =	
	5	

LRU _____

Sec. _____

Range _____

Township _____

APPENDIX E

STUDY TEAM MEMBERS

John C. Bedell - Watershed Forester, Sitgreaves National Forest, Holbrook, Arizona.

Eight years experience with the Forest Service in the Southwestern and Pacific Northwest Regions, on various assignments including watershed, timber management, and Ranger District administration. Bachelor of Science, University of Arizona, in Waterhsed/Forestry.

Win Green - Wildlife Biologist, Carson National Forest, Taos, New Mexico.

Ten years experience with the Forest Service, including seven and one-half years with the Rocky Mountain Forest and Range Experiment Station at Tempe, Arizona, in watershed and wildlife research. Coauthor of three research publications. Two years as Wildlife Biologist on the Tonto National Forest. Bachelor of Science in Wildlife Biology, Arizona State University.

Thomas J. Holden - Landscape Architect, Coconino National Forest, Flagstaff, Arizona.

Six and one-half years experience with Forest Service in Arizona and New Mexico. Six years as Landscape Designer with Chicago Park District, and one year with a private landscape architecture firm in California. B.A., Landscape Architecture, University of Illinois.

Leonard A. Lindquist - (Team Leader), Forester, Southwestern Region, Holbrook, Arizona.

Sixteen years experience with the Forest Service in New Mexico and Arizona on assignments including Ranger District administration, timber management, and timber sale administration. Bachelor of Science, Forest Management, Iowa State University.

Robert T. Meurisse - Assistant to Director, Division of Watershed Management, Forest Service, Washington, D.C.

Five years of Forest Service experience as a Soil Scientist and Watershed and Soils Staff Officer in Arizona. B.S., M.S., Soil

Science, Colorado State University; Ph.D., Forest Soils, Oregon State University. Author of numerous soil management reports. Specialties in soil chemistry, clay mineralogy, forest ecology and forest hydrology.

Stanley Randall - Agricultural Economist, Southwestern Region, Albuquerque, New Mexico.

Six years of Forest Service experience in New Mexico, Utah and Washington, D.C. Four years experience as Agricultural Economist with Soil Conservation Service and Bureau of Land Management. B.S., Agricultural Economics, University of Nevada. Coauthor of special study of socio-economic impacts of Forest Service programs in Northern New Mexico.

Mogollon Rim Area
Land Use Planning Study

SPECIAL USE PERMIT

- Roads
- Power Lines
- Telephone Lines
- Others

0 1 2 3

Scale in Miles

U. S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE
COCONINO, SITGREAVES AND TONTO NATIONAL FORESTS
1972

Mogollon Rim Area
Land Use Planning Study

FRAGILE AND UNIQUE RESOURCES

(11) Potential Historic Site

Roadless Area

High Archeologic Site Density

Mod. " " "

1 0 1 2 3 4

Scale in Miles

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1972

KEY MAP

Mogollon Rim Area Land Use Planning Study

LAND USE SUITABILITIES

A-C	Amenity Areas
D-I	Amenity and Commodity Areas
J-K	Commodity Areas

Scale in Miles

1 0 1 2 3 4

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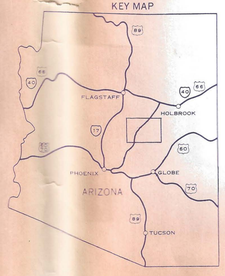
KEY MAP



Mogollon Rim Area
Land Use Planning Study

LANDOWNERSHIP AND STATUS

- Private Land
- Residential Use
- Commercial Use
- Industrial Use
- Recreation and Quasi-Public Use

1 0 1 2 3 4

Scale in Miles

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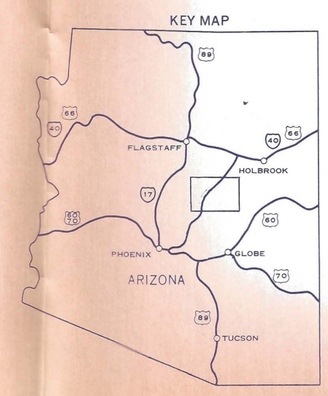
KEY MAP



Mogollon Rim Area
Land Use Planning Study

VEGETATION

- MC MIXED-CONIFERS
- P PINE
- C CHAPARRAL
- G GRASS
- PJ PINYON-JUNIPER
- N NOT VEGETATED

1 0 1 2 3

Scale in Miles

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MOGOLLON RIM AREA
LAND RESPONSE UNIT MAP

R8E R9E R10E R11E R12E R13E R14E R15E R16E R17E

R15½E R16E R17E

T15N T14N T13N T12N T11½N T11N T10N T9N

0 1 2 3 4 5 6 7 8
Scale in Miles